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**AIRCRAFT IN THE GREAT WAR**  
**A RECORD AND STUDY**





# AIRCRAFT IN THE GREAT WAR

A RECORD AND STUDY

BY

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AND

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PAST, PRESENT, AND FUTURE," "THE STORY OF THE AERO-  
PLANE," "AVIATION," "THE AEROPLANE IN WAR," "HEROES  
OF THE AIR," "WITH THE AIRMEN," "THE AIR KING'S  
TREASURE," ETC.

WITH A FRONTISPIECE

LONDON

T FISHER UNWIN

1 ADELPHI TERRACE

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## PREFACE

CERTAIN facts are now beyond controversy, even as regards the use of aircraft in war. Aeroplanes, at the outbreak of hostilities, were reasonably efficient in two respects: (1) as scouts; (2) as range-finders for artillery. But machines were not available for all the work that could be done; nor were there sufficient pilots.

The scouting aeroplane, flying through wind, fog, rain, and hostile gunfire, has enabled a Commander-in-Chief to see, as Wellington longed to see, what is "on the other side of the hill." Several times its work, as will be our purpose to show, has been of supreme importance; and almost always its flights have been useful—augmenting, but not superseding, the patrol work of cavalry. To determine its exact effect on strategy is not easy; the factors are confusing. There is the abnormal length of battle-fronts to be considered, the huge masses of men employed, also the use of motor transport and the general speeding up of operations. But this much can

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be said : the aeroplane has rendered trebly important the factors of time and distance ; and the Commander-in-Chief is most successful who, adapting the tactics of Napoleon to these new conditions of war, strikes a blow so rapid and crushing, at a point where his enemy is weakest, that even if this blow is seen by the air-scouts as it impends, it is struck so quickly, and with such irresistible force, that detection cannot rob it of success.

The co-operation of aeroplanes with artillery, in directing the fire of long-range guns, has proved extraordinarily effective, influencing operations almost as much as has the scouting by air. But it is scarcely probable that such success will be obtained in future wars. The aviator, when range-finding, is obliged to haunt one definite section of the air ; and this renders him susceptible to attack from hostile craft. Even in this war, in its later stages, aerial range-finders were interfered with seriously. In campaigns of the future, unless one flying corps can obtain supremacy in the air, its range-finding machines will be harassed constantly by the enemy's fighting craft.

Of purely fighting aeroplanes, when the war began, there were none—save at least a few experimental craft which had been mounted with

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machine-guns, and betrayed serious defects. This meant that of the two air forces opposed to each other—that of the Germans on the one hand and those of the Allies on the other—neither could deal the other a crushing blow; neither, that is to say, could obtain command of the air. The theory of air war is that you should bring your foe to an immediate combat and so cripple him that, in subsequent stages of the campaign, the efforts of his flying scouts may be frustrated when they seek to penetrate your lines. Thus you blindfold your enemy, while still being able to see yourself.

But in this war, owing to lack of numbers and of means for striking a decisive blow, both the Germans and the Allies have been able to make constant use, for reconnoitring, of their flying craft. And this may be written without depreciating in any way the gallant efforts made both by British and French pilots, and frequently with success, to shoot their opponents in the air with rifles and revolvers, and make up by their determination what they lacked in armament. But though these tactics, in certain areas, produced for a time definite results, there was no question of so crippling the enemy that he was robbed of the aid of his flying scouts.

One of the surprises of the war has been the

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use made of aeroplanes in destructive raids ; although it is not yet possible, owing to a dearth of suitable machines and an inability to drop bombs accurately, to effect damage that has military significance on any fortified position. But in attacking airship stations, or ammunition and supply depôts, which are peculiarly vulnerable, and in raids which may be judged more by their disconcerting influence than the actual damage done, aviators have achieved results which, apart from their spectacular interest, have had a definite effect on operations. And this success has been human more than mechanical. Airmen have triumphed, by their own personal daring, over the limitations of their craft.

Large airships have proved disappointing because, when compared with the aeroplane, they are in a far cruder stage of development. They have not yet been given a weapon, commensurate with their bulk, with which to repel attack. They have the size of a battleship, offering a large target, without the battleship's armour or guns. The Zeppelin has been unable to rise high enough to escape gunfire from the ground. In making a bomb raid by day she courts destruction ; and at night she cannot see to drop her bombs with accuracy. The Zeppelin, as used in this war, has all the

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drawbacks of her size without realizing their advantages. In future, if the aeroplane does not usurp them in weight-lifting, airships will be built larger and will be able to fly higher ; they will carry long-range guns ; and they will be protected against aeroplane attack, as is the battleship against that of torpedo craft, by a screen of small, fast-flying, defensive craft.

The sea-plane has an achievement to its credit in the raid on Cuxhaven ; and it has served the British well as a coast-patrol. For us indeed, from a naval point of view, it is a weapon of the first importance. But in this war, through its frailness and low power, and the risk of destruction it runs when it is compelled to ride on the surface of rough water, the uses of a sea-plane have been restricted. The Cuxhaven raid was possible only because sea conditions were unusually favourable. These drawbacks will be overcome, but only by a free expenditure of money on suitable tests.

It has been our aim, in the pages that follow, to avoid dogmatic statement ; partly for the reason that detailed reports, as compiled from official records, are not yet to hand ; partly also because, in all its uses in this campaign, the military aeroplane is in its infancy, and can give us no more than a suggestion of what will be possible in



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those days when, carrying a crew of airmen instead of one or two, and engined by motors developing thousands of horse-power, such craft will pass through the air, in long-sustained flight, at speeds of two hundred miles an hour, and attack aerial foes, or enemies on earth, with weapons which will, apart from their precision, have powers of destruction we can no more than speculate on to-day.

CLAUDE GRAHAME-WHITE.  
HARRY HARPER.

LONDON,  
*January 1915.*

[*NOTE.*—The authors were indebted, while arranging material for their synopsis, to the excellent weekly summaries, dealing with the use of aircraft in the war, that have appeared in the pages of "*Flight*" and "*The Aeroplane*."] ]

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**PART ONE**

**THE MEN AND THE MACHINES**



# I

## A SPIRIT UNCONQUERABLE

*"In the lexicon of youth . . . there is no such word as fail."*—LYTTON.

IN this, the world's greatest and most dreadful war, there have been deeds which, for sheer courage and daring, have stood out even against a background of man's ceaseless heroism. They have been those of the aviators—waging a warfare that is terrible and strange ; rushing through the air at a hundred miles an hour, thousands of feet above the earth ; menaced by bursting shells or the hawk-like attacks of hostile craft ; tossed about by winds ; in danger, always, of some breakdown that may send them earthward in the enemy's lines ; yet braving each peril with a smile, and joking even when in the presence of Death.

War has brought its heroes always ; but what can one say of these ? These men who, for hours at a stretch, and in a plane that may be swaying in half a gale, will run a nerve-racking gauntlet of shell-fire and then return to their camp and



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write with careless humour to their friends—apropos a German gun which, following them constantly with its fire, has endeavoured to bring them to earth :—

“ They’ve a gun we call ‘ Archibald.’ He shoots extraordinarily well on some days and damn badly on others. . . . Once I heard his beastly shells whistling above the noise of the engine when we came out of the clouds, so he must have been jolly near. . . . ‘ Archibald ’ certainly is a drawback. One has to be rather careful to circumvent him, as the blighter’s shooting has improved wonderfully.”

It is death, and nothing less, that “ Archibald ” sends into the sky—a death that creeps nearer daily as the gunner’s skill improves ; a death that means first a crash and a rending of planes and then a fall through a thousand feet or more of empty air. “ Archibald ” does not always fire in vain. British and French airmen have gone out, and have not returned. It may have been misty and, in order to see what they have been sent to see, they have been obliged to fly low. And then from some concealed position a gun has spoken, a shell has shrieked skyward, and there has been a crumpling of wings and a fluttering, helpless fall—such as of a handkerchief with a stone in it. And that is all, save that somewhere on the war-scarred countryside there is a pathetic mound or a clumsy cross ;

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and perhaps a war correspondent on his wanderings, as was the case with Mr. Richard Harding Davis, stands silently in contemplation, then writes in his dispatch :—

“ The aeroplane had fallen close to the road. . . . At the head of the grave the Germans had put up a wooden cross, on which they had written : ‘ Herr Flier, August 22, 1914.’ . . . The Belgians had covered the grave with flowers.”

Should he run the gauntlet once too often, this is the tragedy of an airman's fate. He sets out with a smile and a wave of the hand. Hours pass and he does not return. Night comes ; nothing is seen of him. Still his companions do not abandon hope. And the next day passes, and several days, and yet no tidings are to hand ; and then, as likely as not by accident, the news filters through that in some field, or at the corner of some wood, there lies the weather-sodden wreckage of a craft, and that it bears the number of the machine the missing airman flew.

When the hero has paid the price of his heroism, when he flies out at dawn and does not return, it is his friends and fellow-airmen who remember, with the lingering affection of comradeship, just what he said or did in those last moments during which they saw him alive ; and in some letter from the front, written perhaps by a companion who—like the man who has

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gone—faces with a dauntless courage the risks he ran, we read such a paragraph as this :—

“ Poor little —— ! I shared a bed with him in the billet we had at Maubeuge. He was an awfully nice fellow. Just before he went up he said, ‘ I think I’ll take a stock of tobacco with me in case I get collared by the Germans ! ’ He took the tobacco, but it was no use to him—perhaps it was to the Germans.”

But though they have been shot at ceaselessly from the earth, and attacked viciously by hostile planes, the airmen in this war have done their work—and done it accurately and well. Not one of these men, flying over the enemy with death at his elbow, has risked or lost his life in vain.

## II

### FLIGHTS THAT WILL LIVE IN HISTORY

*"Loss of time is irreparable in war."*—NAPOLEON.

IT was Wilbur Wright who, eleven years ago—as soon as he and his brother Orville had first flown—declared the aeroplane was “a military proposition.” Had he lived, what could he have said to-day? Even he, dogged enthusiast though he was, could not have foreseen this triumph—and a triumph which, so to say, has come at the first time of asking. In their first test, and in a supreme test, aircraft have rendered services which—even in the moderately expressed words of Field-Marshal Sir John French—have been “of incalculable value.” And that expression of our Commander-in-Chief, at any rate in one case, means simply this: that our air-scouts, thanks to the rapidity and accuracy of their observations, helped to save our army from annihilation. And this one instance, which is destined to become historic, has a fascination which is all its own, apart from its import as an act of war. Here, briefly told, is the story of

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the first test of our Flying Corps ; a test from which it emerged with so much honour that, even in the eyes of those past masters of aviation the French, it won unstinted praise.

It was in the first stage of the war, and in the fighting on the Franco-Belgian frontier. The British Expeditionary Force, pushed forward hastily after its landing in France, had taken up a position on the French left. We had two army corps facing the enemy, with another in reserve ; and the corps which were actually in the fighting line held a position which extended from Condé to Binche. So matters stood on August 23rd, and it was on the evening of this day, quite unexpectedly, that Sir John French learned by telegram from General Joffre that the Germans—having battered Namur into submission at amazing speed—had thrust their way across the Sambre, and were forcing the French to retire. The telegram ended with even graver news. Our two British corps were, it said, threatened by three German army corps on their front, and by a fourth which was stealing round them for a flank attack.

The position could not have been more critical. The French, falling back, left our army exposed ; on neither flank had it protection. And the Germans, pressing forward irresistibly, were on the eve of a crushing attack. Evening was at hand, it will be remembered, before Sir John French had this news ; a few hours only of daylight remained.

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Yet to hesitate was to court destruction. Something must be done, and done at once; the menace was one which could be met only by a swift, unwavering plan. That night the Commander-in-Chief must frame his scheme, and at dawn his army must be in motion. But there was a preliminary, and a vital one; this was to ascertain, if there yet remained time in which to do so, the exact positions and approximate strengths of the threatening hosts. Cavalry scouts of course were available, but conditions were against them; the area to be traversed was large, darkness almost at hand. Next morning, perhaps—but next morning would be too late. Information was needed now.

Here, made for them by circumstance, was just the opportunity our flying men required. Not only was scouting needed, but it was needed in haste—in such haste, indeed, that no craft, save the aeroplane itself, could have brought back the news in time. In a flash there went a message to the aircraft base, and out upon their errands flew the fastest scouts. At twice the pace of an express train, rushing smoothly through the air, went these high-speed craft; and their pilots, peering down on the land below, had a view as from a mountain-top. Out and away, each machine on its given path, sped these flying scouts. And in an hour, thanks to their tremendous speed, they had gleaned news that could have been procured only in a day by any other means.

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They found the hostile forces that were destined for a main attack, marked their positions on their maps, made estimates of their strength; they located also, with accuracy, the flanking movement that was so grave a menace. And this work was done, as it needed to be done, at lightning speed. The aircraft had leaped upward and disappeared; then, in a space of time that seemed incredibly short, they were swooping earthward again, their mission done. Sir John French, given the news he sought, and by an instrument of which he, of the great commanders in war, was the first to make striking use, was able to frame his plans that night with swiftness and precision; and next day at dawn, showing a doggedness that can never be forgotten, our little army began its hazardous retreat.

This is an instance, merely, of the work of our aircraft in the war; there are many others. But this one case is striking, apart from the fact that it influenced the campaign; and the reason is that there entered into it so definitely the question of a time factor. News was needed, but above all else it was needed quickly; and here, in just this very need for haste, lay the triumph of the aeroplane, which is the super-scout of modern war. Sir John French, when he made so masterly a use of this new machine, must have reflected that, of the great generals of the past, none had been able to command such aid. Might not Napoleon, had there been

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aeroplanes at Waterloo, have avoided the blunders of that fatal day? He was under the impression, after the battle of Ligny, that Blücher was retiring towards Liége; but an air reconnaissance would have told him that Blücher, instead of moving east, was actually marching north—was, in fact, on the road to Wavre, with the intention of joining Wellington; while another vital point the air-scouts would have revealed was that Wellington, his movements shielded by cavalry, had withdrawn from Quatre Bras. It was Napoleon, one may recall, who wrote :—

“ Nothing is more contradictory, nothing more bewildering, than the multitude of reports of spies, or of officers sent out to reconnoitre. Some locate army corps where they have seen only detachments; others see only detachments where they ought to have seen army corps.”

And Macmahon, just prior to Sedan? Might not he, had he been able to command the use of aeroplanes, have escaped that fatal trap upon the Meuse?



### III

## AIR CORPS AT THE FRONT

*"I wish particularly to bring to your Lordship's notice the admirable work done by the Royal Flying Corps under Sir David Henderson. Their skill, energy, and perseverance have been beyond all praise. They have furnished me with the most complete and accurate information, which has been of incalculable value in the conduct of the operations."*

SIR JOHN FRENCH TO LORD KITCHENER.

THERE is a fact of which we, as a nation, may feel legitimately proud ; and it is that we have been able to put into the field in this war, and at a critical moment, an air service which has become the admiration of the world. Though our corps in France is small, its equipment has been wonderful ; and our airmen, thanks to the splendid human material which they themselves provide, and to the system of tuition through which each of them has passed, have done work which has been uniformly successful.

This, we must remember, is an achievement by a nation that in aeronautics, and until a year or so ago, was reckoned almost a laughing-stock. It reveals an executive and organizing ability which, in its quickness and thoroughness, should

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give material for thought to those critics who, in season and out, harp constantly upon a dreary theme—that of Britain's inefficiency.

It was a proud moment for Major-General Sir David Henderson, during the time he was in charge of our air service at the front, and for the officers and men who have co-operated so admirably with him, when King George—paying a visit to the troops in Northern France—inspected the headquarters of the Flying Corps. The scene is described by our official “ Eye-witness ” :—

“ His Majesty addressed the officers and men of the Corps. Machines were being overhauled and repaired in the workshops, while in the aerodrome others were starting out on reconnaissance duty or returning. His Majesty inspected one of the captured aeroplanes and witnessed some special flights, showing the same keen interest in military aviation that he has always evinced. Indeed, the scene of great activity presented by that portion of the Corps present at General Headquarters must have seemed a strange contrast to that other scene at Farnborough some two and a half years ago, when the King for the first time inspected the R.F.C., then in its infancy, the total muster being six officers and two inferior aeroplanes.”

The war has proved that, in a military aeroplane, there are two qualities which are supreme ; and it is again to our credit that we, in England, should have anticipated both. One is that a machine should fly fast, the other that it should

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ascend quickly. Speed, as we have shown, is vital when scouting; and it has a value even apart from this. An aeroplane, if it passes rapidly through the air, offers a difficult mark for those who are firing at it from the ground; and the faster it flies the less chance there is that it will be hit.

Rapidity of ascent, besides carrying a pilot out of danger should he come suddenly within the range of guns, provides him with an advantage if he is confronted by hostile craft and needs to manœuvre swiftly for a position of attack.

And what is called "airworthiness" has a value also. A military pilot, when on active service, cannot afford to be a fine-weather flyer. He must ascend in winds as well as calms. Nothing, save a tearing gale, must keep him to the ground. Sir John French, in this regard, has paid our pilots a tribute that is comprehensive. They fly, he says, "in every kind of weather." Such airworthiness is gained by a scientific shaping and placing of the planes of a machine; by the fitting of stabilizing fins; and by a minute adjustment of the weights that have to be borne through the air—pilot, engine, and fuel. Nor must one forget, in this ability to fight the wind, the growing skill shown by the airmen themselves. This enabled them on one occasion, when information was required urgently, to ascend in a wind so strong that, at a height of 3,000 feet, it was blowing at a velocity of nearly ninety miles an hour.

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Germany, when war came, was better prepared in regard to her air service than any other nation. She had made immense efforts, knowing that she herself meant to break the peace. No statistics that are reliable can be quoted—Germany has seen to it that none should be forthcoming; but it is fair to assume that, when hostilities began, the German air fleet numbered more than one thousand machines. They were reliable, well-built craft—strong, powerfully engined, and stable when in winds; but neither in speed nor in climbing, save with certain exceptions, were they the equals of British craft.

The French air corps, after serving as a model for the world, was at a disadvantage when war came. Built up hastily, under the stress of a great enthusiasm, experience showed that there were laxities in its system. Abuses had crept in, craft had deteriorated, and the training of the men had grown slack. So the need arose for a rapid and drastic change. Machines that were declared obsolete were discarded wholesale; money was spent freely, and the training of pilots and observers became far more stringent. But France had scarcely time to benefit by the change. When Germany declared war on her she had an air fleet of perhaps five hundred or six hundred craft; but neither in organization nor in material was she the equal of the Germans; and it was not until some time after fighting had begun—not, indeed, until the first

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critical phase had been passed—that her aircraft were able to do really vital work.

Russia, when called to play her part, had several hundred planes ; and her pilots are men of rare courage and determination. Austria had a small but fairly efficient air service. The Belgian pilots were few in numbers but of remarkable daring ; while Britain, hitherto regarded as the laggard, sent about a hundred machines to France, and with them, in a few weeks only, gained what Sir John French has described as “ something in the direction of the mastery of the air.”

Here, indeed, is an amazing fact of an amazing war. Armed with nothing better, as a rule, than rifles or revolvers, our pilots sought out the Germans in deliberate conflict and, through being able to fly faster and rise higher, secured such a tactical advantage, in the first manœuvres for fire, that they shot down some of their opponents at point-blank range. In the old days, with sailing-ships, it was the nimbleness of our craft and the adroitness of their handling that won them triumphs over larger foes ; and now our British pilots, in this new element the air, have recalled to us the times of the Armada, and have shown us that—in duels of the sky as well as of the sea—it is quickness and boldness that are apt to win the day.

But in this, of course, apart from training or the excellence of machines, there is something temperamental. A typical British officer—cool,

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adroit, and with that daring which is seen to advantage in an emergency—makes the ideal aviator ; while the typical German, who learns to fly with meticulous care, and handles his machine with a high average skill, does not possess at a crisis just the spirit of initiative which, in aerial fighting more than in any other, spells the difference between victory and defeat.

The British air service has, from its inception, attracted the finest types of men. They are young men and keen men ; men determined to get on, and ready to run risks in order that they may do so—the sort of men who, in days of old, would have gone cheerfully with Columbus, or sailed to capture gold-ships on the Spanish Main.

## IV

### THE CRAFT THAT ARE FLOWN

*"Whatever may be the influence of the art of flying on the future developments of civilization, this influence is, as yet, apparent only in one direction—that of warfare."*

MAJOR-GENERAL SIR DAVID HENDERSON.

AIRCRAFT in the war, the machines the men have used for their perilous tasks, need no long description. They may be grouped, briefly, into three types. First there is the machine in which a pilot ascends alone—either a biplane or a monoplane; and this is a craft for speed. Its planes are small; they just bear their load, and nothing more; its motor is powerful, and its body so sloped that it offers a minimum of resistance to the air. With its engine roaring, and a gale of wind blowing in the wake of its propeller, this machine will leap across the ground and spring into the air, climbing for a spell at an amazing pace, and then settling down, with a droning hum, to that sheer rush of speed that renders appropriate its nickname of "the bullet." British pilots, having in view the pursuit of

## The Craft that are Flown

slower-flying German craft, have called these little machines "the chasers."

Their speed, thanks to their lightness and power, has been phenomenal. One of the latest type, built by the Royal Aircraft Factory, a biplane with an engine of 160 h.p., has attained a pace of more than 130 miles an hour. Naturally a machine of this abnormal type, in which everything is sacrificed to speed, requires great skill in its handling. None but an expert would dare to pilot it, because in rising or descending, unless perfect judgment is shown, it may swerve suddenly or overturn. But in making a rapid reconnaissance, when every hour is vital, in avoiding gun-fire by the sheer speed at which it flies, and in rising to fight a hostile craft, this "bullet" type of biplane has fully proved its worth.

Sometimes it may happen that more detail in observation is needed than would be feasible with these high-speed scouts; and here there is scope for another type of craft: a slower-flying biplane or monoplane, which will carry a passenger as well as a pilot. The task of the passenger, an officer skilled in observation, is to take up in the air with him his maps and glasses and devote himself entirely, while the pilot steers, to a study of the land below. From such a machine, flying for several hours above an enemy's lines, it is possible to make a full and accurate survey. But, remembering that war is war, the men in this craft have to



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run grave risks. They may be overtaken and attacked by faster machines ; that is one peril ; or as another, and this a ceaseless one, they offer a better target than do the "bullet" machines to the fire of an enemy's guns.

Then there is the airship ; large, unwieldy, and offering—as an artilleryman puts it—"a mark like a haystack" to the gun-fire from the land. The disadvantages of the airship are many, and her uses in war limited—if, that is, she is to escape destruction. But at the same time she *has* uses. With this craft, more than with any other, the amount of work she does, and the utility of that work, are dependent on the skill of those who handle her.

There are three points in favour of the airship, and none should be overlooked. She can remain in the air many hours if required ; even, in an emergency, for several days. And in this respect she has the advantage of the aeroplane. She can hover, too, above a given spot, her engines stopped and her car motionless. This is of value in detailed observations ; and here again she has the advantage of the aeroplane, which cannot hover.

A third merit of the airship, and again a useful one, is that she can fly safely at night. This provides her with many uses in time of war. Aeroplanes can fly at night too, but only at grave risk. If a motor fails, and the airman has to descend, darkness prevents him from choosing a landing-ground, and he may crash

## The Craft that are Flown

into a wall or a hedge, or the side of a house, or find himself in the tree-tops of a wood.

Hovering at the rear of her own lines, and fitted with a powerful wireless plant, the airship can remain aloft from dawn until dusk, her observers watching constantly the enemy's battle-front and signalling, while the news has value, any change they may notice in the position of the troops. For destructive raids, particularly at night, the airship has a grim potentiality ; but this is a problem that will be discussed later in our book. The point to be borne in mind, the fact that governs the use of an airship in war, is that in a clear sky during daylight, and away from the protection of her own guns or planes, she is large, slow-flying, and highly vulnerable. Her hull cannot be armoured, fragile though it is ; the weight would be prohibitive. So she may be crippled and sent to earth by the accurate placing of a single bomb or shell.

The policy of an airship pilot must be to do his work by stealth : he must not allow himself to be caught in daylight or in a clear sky. Darkness is his best protection ; and so we find in this war that the airship is a night bird, stealing out from its shed at dusk ; and this to the disgust of the pilots of our Flying Corps, who went to France with the hope that they might be able to "drop an orange"—and by this they mean a bomb—on the hull of some German Zeppelin. As a matter of fact, and this after

## Aircraft in the Great War

a number of weeks of war, an official report contained the significant lines :—

“ The Royal Flying Corps, who have been out on reconnaissance every day since their arrival in France, have never seen a Zeppelin. . . . There is disappointment at the absence of these targets.”

But German airship pilots have their own point of view ; they have no wish to become “ targets.” So they limit themselves almost entirely to night flying, and to such tasks as may expose their craft to the least risk. But, even so, their anxieties are many ; and the lesson of the war is that, unless he has unusual judgment, and unusual luck also, an airship pilot is bound, ere long, to lose his craft by gun-fire or the bombs of hostile craft. Half a dozen Zeppelins had, during the operations up to mid-December, been brought down by the Allies' guns.

**PART TWO**

**AERIAL STRATEGY :  
THE MOVE AND COUNTER-MOVE**



## I

### AIR-SCOUTS AND THEIR FOES

*"No aircraft has yet been produced which would be able absolutely to prevent a hostile aeroplane from carrying out a reconnaissance."*

MAJOR-GENERAL SIR DAVID HENDERSON.

THE science of war either on land or sea is, as this war has shown us, very much the science of war in the air. Main rules, indeed, are largely the same; it is merely the element, and the machines, that differ. When in modern war a new weapon is forged, and proves of importance, it becomes instantly the aim to checkmate it, to rob it of its power. This is the science of move and counter-move—the same striving, always, to bring defence abreast of attack, or *vice-versa*. The torpedo-boat evolved the torpedo-destroyer; the Dreadnought was followed by the super-Dreadnought; and, providing there is money in the Treasury, this work of rivalry continues, piling weapon on weapon, and defence on defence, until those who control all this mechanism cannot foresee what will happen in actual war.

In the air this problem of the counter-stroke,

## Aircraft in the Great War

as it is known on land or sea, becomes extremely complex. One has, let us say, the air-scout, the powers of which we have outlined. Machines such as this cannot obviously go unchallenged. As soon, then, as an aeroplane scout became practical, and to be reckoned with even in the stress of actual war, plans had to be made to hamper it in its work. There were two ways of doing this. One was to fire at it from the ground ; the other to attack it in its own element, the air.

But the aeroplane, at any rate in this war, has had good fortune on its side. In its perfection as a machine it has outstripped all methods of attack. It has become an instrument of precision, ready to a Commander's hand, while the anti-aircraft guns, and the flying machines intended to be aeroplane "destroyers," are still crude and experimental ; unable, indeed, to do more than suggest their final power. Air-scouts, it is true, have been struck by gun-fire, and some brought down by hostile craft ; but the essential fact remains that one army has been unable to prevent another from scouting above its lines. When news of the enemy has been needed, several machines have gone out ; and, though one or two may have failed to return, those which have come back, and have handed their reports to headquarters, have been able to learn all that it was required to know.

Anti-aircraft guns, weapons which may be pointed vertically upward, and are mounted, as

## Air-Scouts and their Foes

a rule, on motor-cars, so that they may be moved rapidly from place to place, have been handled in this war with skill. They fire a shell which can be made to explode at a given altitude ; and, when it bursts, it emits a cloud of bullets which scatter on all sides. These guns have a long range ; they can send a shell higher than any aeroplane will fly when scouting. They are built, also, so that they can be sighted with rapidity ; and they fire first a smoke-shell which, making a tell-tale passage through the sky, gives its gunners a guide as to the height of the machine they are seeking to destroy.



## II

### AEROPLANES AS TARGETS

*"High speed, frequent changes of direction and elevation, and movements in curves and in a plane oblique to the horizontal, will in all circumstances reduce the probability that the enemy's guns and rifles will obtain hits."*

FIELD SERVICE REGULATIONS.

THE result of gunfire, as directed against aeroplanes, has not been what we were led to believe it would be—at any rate, by artillery experts. Some declared that, merely by this fire from the earth, aircraft would be checkmated. But the lesson of the war is simply that they have not been. Shells have been hurled skyward, it is true, with a lavish disregard of cost, the Germans, notably, having filled the air with their projectiles. And yet—save that here and there an aviator has gone to his death—the planes have passed to and fro upon their work; and the reason for their having done so is that they form an abnormally difficult target. It needs no technical knowledge to realize this. Imagine a machine 8,000 feet high, and moving at more than a hundred miles an hour. It sweeps into

## Aeroplanes as Targets

a gunner's view, appearing no bigger than a bird on the wing. Swiftly, with such erratic twists and plunges as the pilot himself will contrive, so as to make his machine still more elusive, it will pass across the sky and be lost to view. The gunner, in the brief space that it is within range, has to send up his testing shell, make his estimate of height and speed and any adjustment of aim that may be necessary, and then strive—by the sheer quickness of his fire—to wing the craft before it has vanished from his sight.

What the problem resolves itself to is this : an airman, even on a detailed reconnaissance, may fly high enough to carry him beyond the range of rifles or machine-guns ; but he cannot rise above artillery fire—not, that is to say, if he is to make useful observations. But his speed is so great that, even if he is within the range of artillery, it is a matter of enormous difficulty to hit him. The aeroplane may, between the shells a gunner sends aloft, alter materially both its altitude and direction. What the artilleryman needs is a large, automatic, quick-firing type of gun, which will throw into the air a continuous stream of shells. A really formidable gun of this type, luckily for the airman, does not exist at present, although there are quick-firing weapons which will throw a series of small, 1-lb. shells ; while the Germans have a type of high-angle gun, firing shrapnel, that is semi-automatic.

What has happened as a rule, in this war, may

## Aircraft in the Great War

be summarized in the words of an eye-witness, who watched a French aeroplane pass above the enemy's guns :—

“ The Germans turned their attention to this aeroplane, and for several minutes it was surrounded by bursting shrapnel. Most of them were far away, nearly always behind the machine, which glided gracefully on its way, until the gunners gave up their work in despair.”

But, as a matter of fact, a gunner never gives way to despair. He is patient and watchful ; he does not lose heart. He knows that some day, over some field, there will be an aeroplane flying low in its search for news ; and then if he is on that spot, and in a position well-concealed, his weeks of waiting will have their reward. He will fire his marking shell ; and after this, so quickly that the aviator cannot wheel or dodge to safety, he will have followed it with another and a well-timed shot, and the craft—crumpling as though struck by a cyclone—will pitch brokenly to earth.

### III

## DUELS IN THE AIR

*"Until a fighting machine has been produced which will equal an unarmed aeroplane in speed, in climbing power, and in handiness, there can be little doubt that a resolute enemy, with a reasonable air force at his disposal, will be able to get such information as aerial reconnaissance can acquire."*

MAJOR-GENERAL SIR DAVID HENDERSON.

IF against flying craft the land-guns are largely impotent—and in this war they have been—there is still the attack from the air; and here, as we have indicated, there is scope for daring work. But, when arming a machine for a duel in the air, there is one adverse factor to be reckoned with. Even a motor of 200 h.p.—and this is almost the limit to-day—gives none too much power for a large and heavy craft; and for this reason, if a machine has a gun and ammunition, and carries in addition the weight of a pilot and a combatant, its pace may be so reduced that, when it seeks combat with some high-speed hostile scout, it will fly so slowly that the enemy—having no such burden to check his pace—can fly out of range and so escape.

## Aircraft in the Great War

The high-powered aeroplane "destroyer" is a machine of the future. With existing craft, and with motors available, if a machine is heavily armed it will fly too slowly. In this war, therefore, at any rate in its early stage, the combatants who were successful were single pilots, each in a high-speed craft; and they pursued the enemy's scouts and darted at them boldly, seeking to "wing" them with a rifle or a revolver. In such desultory fighting no conclusive results are to be obtained. Machines have been put out of action; dramatic duels have been fought; but there has been no means of gaining a command of the air. To this extent aerial fighting has failed in its purpose; and this purpose has been to offer such a barrier to the enemy's scouts as they would fail to penetrate; to duplicate, indeed, in the air, that screen against observation which cavalry maintain on land. Had there been enough machines, and had they been sufficiently fast and well armed, such command might actually have been secured; but as it is the air-scout, who represents an all-seeing eye, has been hampered merely in his work, and this to no great extent, instead of being driven from the air.

## IV

### AIR-SCOUTING AND TACTICS

*"Surprise the enemy by strategy and secrecy, by the unexpectedness and rapidity of your operations."*

NAPOLÉON.

AS he cannot be checked, as his spying cannot be avoided, the air-scout has been a factor in this war to be reckoned with in every movement of troops. It was thought, a year or so ago, that the presence of these observers, high in the air, would revolutionize the tactics of war. The experience we have now gained shows us that, though war is not easily revolutionized, the air-scout has played an extraordinarily important part. But flying has not been the only factor to be considered; abnormally long battle-fronts, and the hugeness of the forces engaged, have brought up problems that were never faced before. War has changed, and so materially, that the change is difficult to comprehend.

To-day, when great nations fight, there is scarcely a possibility—as there was, say, in the times of Napoleon—for a swift and brilliant

## Aircraft in the Great War

master-stroke. In wars of the past, when two armies, each, for example, of 100,000 men, were engaging each other closely, the throwing against the flank of one of them—by some quick and dexterous move—of a force say of 30,000 men, might prove sufficient to turn the tide, and give victory to the Commander who had planned the stroke. But in this great war, and particularly in such a battle as that upon the Aisne, a flanking movement by 30,000 men would, owing to the smallness of such a force when compared with the bulk of troops engaged, fail in its object. With 300,000 men perhaps, detached for a flank attack, there might be some result. But the movement of such a force as this is slow ; it cannot be flung impetuously at a critical position. And this point, too, must be remembered : while such a force is being assembled, at some point behind the fighting line, it is the duty of the air-scouts to discover it, and to follow it when it is in motion. Thus the blow, even when it is struck, is robbed of its prime object : it fails to surprise. The force has been watched in its formation, and in its movement into action ; and the result is that, at the point which is threatened, more troops have been shifted into place, and force is met by force.

Granted efficient air-scouts, and an enemy unable to prevent their work, a Commander-in-Chief should know exactly, from day to day, not only what his opponent is doing at the moment, but where his reserve troops are being

## Air-Scouting and Tactics

moved, and at what points his battle-front is being strengthened or thinned. The element of surprise, once so vital in war, has been almost eliminated. It is of no avail for one Commander, a subtle move in mind, to augment his screen of cavalry, and press back the enemy's land-scouts. It is not they so much he needs to fear; it is the new scout, the enemy's super-scout, who passes high above his cavalry and penetrates deep within his lines, watching the assembly of the transport trains, and noting that bustle in the camps, and those clouds of dust along the roads, that speak of the movement of large bodies of men.

Here the reader may say: "You assume the aeroplane to be an unfailing weapon—that it can be used all day and every day. Is this so?"

So far as the wind is concerned, which was once the airman's greatest foe, he has conquered definitely. Even a gale, nowadays, has no terrors for an expert pilot: if his machine is of the latest type, and has an engine as powerful as it should be, and granted he has a fairly open space from which to rise, he can fly in a wind of sixty miles an hour. This, from a military point of view, is enormously important; practically it means, to quote the words of Sir John French in his tribute to our corps, that aviators can fly "in every kind of weather."

There are mists and fogs that will interfere with a pilot's view; and at such times he must wait until the weather improves. But mists



## Aircraft in the Great War

are often very local—clinging merely to some limited space of ground ; and, in the ordinary way, they do not continue long. And the airmen, with important work on hand, are ready to fly at a moment's call. Even if it is a foggy morning, they may be able to do their work in the afternoon ; or, should it be misty all day, there may be a breeze just at dusk ; and this, clearing the air, will enable them to fly out and return before dark. Here, indeed, the pace of the aeroplane is vastly in its favour. It does not require a day or days ; one hour sometimes, or at the most two or three, and its work is done and it is back in its shed.

## V

### COMMAND OF THE AIR

*"Throughout a campaign, where both sides are sufficiently equipped with aircraft, the game must be played with cards on the table."*

MAJOR-GENERAL SIR DAVID HENDERSON.

WAR has changed ; we have, in this campaign, seen it change actually from day to day ; and the aeroplane, handled with an adroitness beyond praise, has played a part that is vital in altering rules of strategy. With surprise eliminated—thanks to the aeroplane ; with such huge forces engaged that a flanking movement becomes one of extreme difficulty ; with artillery, machine-guns, and modern rifle-fire, which render a frontal attack so ghastly in its toll of life—with these, indeed, confusing and hampering the plans he may devise, a Commander must find ere long that he has but one idea in mind, and this to strengthen and maintain intact his ever-extending front.

The strategy of this war, owing largely to the use of aeroplanes, and as it has been studied in Belgium or France, may be illustrated perhaps as follows : the Germans move up troops, say,

## Aircraft in the Great War

to their right wing, but this is observed by British air-scouts, and so we strengthen the point menaced ; then the French, perhaps at a point to the eastward, assemble two army corps for a flanking movement ; but this, in its turn, is detected by German aviators ; and so, again, it is a question of move and counter-move. There is only one result to such constant check-mate : the opposing battle-fronts, stretching mile after mile until it becomes a journey of days from wing to wing, are bound in places to grow weak. The problem is one of men, of endurance, and of staunchness in resisting attack. What such warfare means was explained clearly, in regard to the battles of the Aisne, by a French expert who was quoted by Mr. Ward Price in *The Daily Mail*. He said :—

“ You have the two lines of the hostile armies facing each other, both entrenched. In some cases the trenches of the Allied troops and the Germans are less than four hundred yards apart. You have a most terrific artillery fire going on all the time. The result is a virtual deadlock all along the front. Accordingly you try to turn your enemy’s flank by moving troops to a wing, so as to get a preponderance of force there. Immediately your move is met by a corresponding movement on the part of the enemy.

“ Your new men on the flank have to dig themselves in—it is the only human way of withstanding the frightful artillery fire that is characteristic of this war. The enemy does the same. There you are, both immobilized again, one in

## Command of the Air

face of the other, and you have to begin another flanking movement afresh, met in its turn in a corresponding way. That sort of thing is slow, but it is the way that victory is gained in modern war.

“You win by slowly and gradually wearing down your enemy, by destroying little by little his moral as well as his physical strength, and asserting the superiority of your own.”

Napoleon, could he watch the warfare of to-day, would surely find it dull and tedious ; so probably would Hannibal, or any other general of antiquity. Science seems to have striven, by a sheer perfection of mechanism, to eliminate the element of genius—that factor of personal strategy which has so fascinated a student of war. Instead we have vast and unwieldy bodies of men, battering at each other for weeks on end, with a ceaseless and deafening roar of artillery, and victory dependent not so much on brilliant generalship, as on the sheer power of an army to withstand the blows rained at it.

What would Napoleon have done in such conditions? One thing certainly he would have striven to do, and it is a task upon which the Commander-in-Chief of the future, if he is to have any chance at all of victory, will need also to concentrate ; and this is to obtain command of the air and cripple the enemy's flying scouts. Until he can rid himself of these intolerable spies, the superior strategy of one Commander, even should he possess it, cannot be used to its

## Aircraft in the Great War

best purpose. Secrecy must be obtained somehow, in some way, if a crushing blow is to be struck ; but with an enemy's air-scouts in the sky, flying unchecked, such secrecy is impossible. That is the lesson of this war, and a vital one ; and a lesson by which, in future plans for war, each nation must seek to profit. Command of the air—such is the supreme need. And it must be won first of all, in the earliest stage of a campaign ; must precede the command of land or sea.

**PART THREE**  
**THE GAUNTLET OF DEATH**



# I

## THE AIRMAN'S ORDEAL

*"That old gun has been at us every day."*

A BRITISH PILOT.

SOMETIMES, in the daring of what he does, a man will outstrip all power of pen, and place on record a feat to which—in ordinary words and in an ordinary tongue—it is almost impossible to do justice. It is so with the aviators who, flying deliberately into danger-zones, have risked death a hundred times a day, and reckoned their own lives of no account, granted only they could gain the news their Commander sought.

Others of course, in this war, have grown familiar with death; it has been at their elbow day or night, at breakfast or at tea, in the trenches or when sheltering behind a wood. But death on the land is one thing, and death in the air another. There is something appalling to men's nerves, something dreadful and inhuman, in the rush through the air of a frail machine, thousands of feet above the countryside, with guns levelled at it, and shells bursting all around; with the pilot crouching low at his levers in the vibrating hull, seeing the white smoke-clouds of the shells



## Aircraft in the Great War

as they flash here and there, some bursting to his right, some to his left, some above, some below ; and with the thought always in his mind that, as each of these shells comes wailing aloft, it may bring with it destruction and sudden death.

And the airman has other concerns, other worries, besides knowing he is being shot at like a driven bird. He has a high-speed machine to control, and this, should the wind be high, may mean hard and ceaseless work. He has a dashboard of instruments to watch—height recorder, speed gauge, engine revolution counter ; and he must keep an ear also for the running of his motor, so that he may be able to tell instantly, from any change in its rhythm, if a valve or rod has broken, or a cylinder ceased to fire. He has a map fixed before him which he must study, and a compass which guides him on his course. He is aloft, not merely to run the gauntlet of death, but to observe some given tract of country, to see what troops are upon it, and in what direction they are moving, and to return to his headquarters without delay.

## II

### A STORY OF HEROISM

*"Any information the observer obtains is useless unless he brings it back."*

MAJOR-GENERAL SIR DAVID HENDERSON.

IF it is a fine, clear morning when he motors to the sheds, the aviator will heave a sigh of relief. It means that, even when he is observing the earth closely, he may fly high and run less risk from the guns. But if it is misty, with a sluggish, troublesome haze near the ground, and should the reconnaissance upon which he flies be of special importance, then he must set his teeth and steel his heart, for he will need to play with death this morning, and at close range.

This is the pilot's gravest risk: nearer and nearer, sometimes, must he creep to earth, peering over the side of his machine, if he is to distinguish some movement that is in progress below. He knows his peril—none better; but it must be endured, and that deliberately; and here, surely, is heroism worthy of the name. In a nerve-trying suspense, knowing that at any moment, from behind some wood or from some

## Aircraft in the Great War

hidden road, there may come the flash of the gun that will send him to his death, the pilot sweeps fast above the countryside. The drone of his motor gives full warning of his approach ; and this makes his risk the greater.

It happens often, even after he has thrust his head, so to say, into the lion's mouth, that the airman escapes. M. Paulhan, for instance, the famous French pilot who emerged from his retirement when the war came, and has served his country with distinction in the air, tells a story of such an escape from death. He was scouting with a passenger during the fighting on the Somme, and low-lying clouds forced him near the earth. Then suddenly the aeroplane came under a storm of fire. M. Paulhan, in a letter to Mr. Holt Thomas in England, says :—

“ My passenger received a bullet through the map he was holding in his hand, and a second bullet hit him in the foot. The third bullet was for me. It entered at my ankle and went out above the calf. I was eighteen kilometres from Headquarters, where I had to put in my report. I lost a good deal of blood, but got back all the same, piloting only with my uninjured foot. As a matter of fact I got back only just in time, and was immediately transported with my passenger to the hospital.”

Here, in the words of a man who flies, one has material for a drama of the air. Paulhan was flying so low, evidently on a special task of observation, that he was well within rifle-

## A Story of Heroism

fire—a position of extreme peril. Clearly, too, the volley that was poured at him came by way of a surprise. First there was the bullet that ripped its way through the military observer's map, which he would at the moment be studying, so as to find landmarks on the country over which they flew. Then, an instant later—proof of their nearness to the men who fired—there came the bullet which, after penetrating the floorboards of the hull, pierced the passenger in his foot. Now of course—directly, indeed, the first shots came—Paulhan would have swerved and begun to climb. But he was too near the earth to escape. There came this third bullet from the enemy which, again penetrating the footboards of the hull, found its billet in his leg.

One needs to form a mental picture of what this crisis meant. Here were these men, both wounded and losing blood, in an aeroplane over an enemy's country, and with more than ten miles of flight before them ere they could regain their headquarters. Both were in pain, and growing faint. The passenger's life lay in the hands of the pilot. Should Paulhan collapse, and sink over his levers, then the aeroplane would reel and sideslip, and fall to earth. And, had he sought to land at once, there was almost certain death to face, seeing that volleys would have been fired at the machine as it neared the ground. Even had they reached earth safely, it would have meant capture for themselves and the loss to the French Staff of the news they had gleaned.

## Aircraft in the Great War

There was one other thing to be done, and Paulhan attempted it: this was to turn his machine and fly back the ten miles to Headquarters, hoping that he might not faint, through exhaustion, before he reached his goal and planed to earth. This flight may be imagined. The passenger, knowing his life was in the other's hands, would sit silently with his eyes upon him; and Paulhan, superb pilot that he is, would husband his strength. But even so, and in the simple words which are typical of this man, "*I got back only just in time.*" There is everything in these seven words—a story of man's heroism, of a fight with death.

### III

## FIRED ON BY FRIEND AND FOE

*"I had some fun one day; I was plugged at by guns for about an hour."*—A BRITISH PILOT.

ONE thought may arise to the mind, after reading of such an adventure as that of Paulhan and his passenger: why should not an aeroplane, if it is to be subjected to gun-fire, be protected by armour so as to resist the penetration of bullets? Had machines been so shielded, as the war shows us, many men might have been saved from wounds, and some from death. But steel-plating, even if it is of the lightest, spells weight; and weight is a drawback with machines that fly. Every extra pound carried may mean a loss in speed; and speed, as we have said, cannot be sacrificed in war—not even when it is a question of human safety.

In days when aeroplanes are far larger, when motors of thousands of horse-power instead of hundreds are available, then conditions will be different; but to-day, if a machine is to be manœuvred quickly, and fly at high speeds, it cannot afford the weight of armouring. This state-

## Aircraft in the Great War

ment applies in a general sense. The French, with their usual ingenuity, have made many experiments in the armouring of machines ; and by the use of high-powered engines they have produced craft which, even when they have protected hulls, will fly fairly well. But many of them, besides being slow, are sluggish in control. A compromise that is more effective, and has been adopted with success, is to protect just the pilot's seat, and that of the passenger, with some thin, specially strengthened steel-plating, and leave other parts unguarded. But it is very necessary, if it can be done, to shield motors, fuel tanks, and radiators. In many cases in this war, when under fire, it has been the effect of bullets on his machine, and not on himself, that has brought a pilot to earth. Mr. Gordon Bell, a British pilot, reconnoitring over the Germans during the retreat from Mons, supplies an instance of the damage that may be done by gun-fire to the working parts of a machine. It seems that, when at 4,000 feet, he came first under the German fire, and a bullet passed through the hull and injured him slightly in the foot. He ascended, and had climbed another thousand feet when a bullet struck his motor and stopped it instantly. Mr. Bell's position was not enviable.

“ I was,” he says, “ right over the German lines ; but I turned as quickly as I could and steered my disabled machine in the direction of the British. It was touch-and-go, but luckily

## Fired on by Friend and Foe

I was high enough to plane three or four miles before alighting ; and then I set off to tramp to the British lines."

In another case, brought down by a shot in his engine while flying low, a British pilot had to land close to some German trenches. About a hundred yards away from him—and on the side farthest from the Germans—flowed a river ; and beyond this river lay the British lines. Springing out of his machine as it landed, the aviator ran at top speed towards the river, pursued by a hail of bullets. None of them hit him. Reaching the river, he leaped into it and swam across ; then ran on till he came to the shelter of the British lines.

Occasionally it has happened that, even when an engine has been struck, it has continued to run falteringly, and has just enabled the aviator to regain his starting-point. There is, as an illustration, a typically worded statement from a pilot in our Flying Corps. After being under fire some time, his machine was struck, and he says :—

" It hit my engine but didn't stop it altogether, and as I retired it made noises like a sick elephant. . . . I managed, however, to get back to our landing ground."

Instances have been forthcoming during the war in which, as a rule by shrapnel-shot, an aviator's fuel-tank has been struck and his petrol



## Aircraft in the Great War

drained away ; or bullets have broken his radiator and the water has escaped. In either case, no matter where he may have been, there has been nothing to do but descend. A graphic story to illustrate this—giving an idea of the sensations of a pilot when under fire—is provided by a letter from one of our aviators printed in *The Daily Mail*. He writes :—

“ It was at Maubeuge. . . . We ran into clouds, so had to turn back. As we were coming over the French lines I saw a movement and bustle among the troops, and then there was the noise of about a thousand rifles cracking at us. They had mistaken me for a German because my machine was different from most of the others ! That was my ‘ baptism of fire ’ and I shall never forget it.

“ My first sensations were of surprise, which rapidly developed into a kind of fear, which in turn changed to fascination. It positively fascinated me to see the holes appearing in the planes as each bullet ripped its way through (although there were only a few of them.) I was looking at my instrument-board to see what height I was, when suddenly a bullet hit the board and a splinter jumped up in front of me. At the same time a bullet pierced the petrol tank and all the petrol ran out. Another one hit one of the instruments and smashed it. When the petrol ran out there was nothing for it but to come down, so I trusted to luck, and came down in the first good field I saw.

“ A dozen or so Belgian and French soldiers rushed out, apparently not sure whether I was English or German till I shouted, ‘ Anglais,

## Fired on by Friend and Foe

Anglais ! ' Then they bustled to and did all they could for me. I happened to have two tanks, so I filled up the other one and got ready to start again."

Besides proving the point we wished to make, this statement introduces another and a curious point: it is that, particularly in the early stages of the war, airmen had as much to fear from their friends as from the enemy. Everybody who had a rifle fired at them, Allies and foes alike; and this was due to the difficulty of distinguishing machines, also to the fact that, when on a scouting flight, an airman would appear in sight from any point of the compass. Even were he seen to be flying, say, from behind the French lines, he could not be reckoned a friend; and so the only thing to do was to take a shot at him on chance and apologize afterwards—should he happen to be alive.

There is, in this regard, an amusing story: it is told by Mr. C. G. Grey, of *The Aeroplane*, and concerns a member of our Flying Corps who, starting a flight from a point behind the Allies' front, had to pass above a section of French troops on his way to the German lines. Climbing steadily, he was soon at an elevation of 2,000 feet; and at this moment, looking below, he saw a body of French infantry. They saw him, too, and began without hesitation to fire a series of volleys at him. The point of the story is that this officer, being of a quick temper, and not knowing the meaning of the word "fear,"

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was annoyed more than perturbed by the fusillade, particularly as bullet after bullet began to strike his craft. With a gesture of annoyance, as though this was really too much, he shut off his motor and dived towards the offending French. It was a perilous thing to do, of course, but he did not pause to reflect. Planing as steeply as he could, and with his machine pointed straight towards the French, he landed in a field close beside them, still under a hail of bullets.

French soldiers, congratulating themselves on a hit, hurried to the field to make the airman captive, should he be alive. They found that he was. An angry, gesticulating figure rose from the driving-seat, dressed obviously in a British uniform. Then the pilot sprang to the ground, brushed aside the astonished soldiers who had come to seize him, and walked to the officer of the detachment with the words—

“ I say ! Look here ! Damn it all ! This *isn't* good enough ! ”

Then, having risked a hundred deaths so as to make this typically British protest, he delivered a lecture to the French soldiers on the impropriety of their conduct in pouring volleys into friendly craft.

The nations at war place identifying marks on their machines, but at times these are difficult to see ; and often, in the heat of the moment, men who have rifles will not wait to distinguish

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them. Some craft identify themselves at a glance, and to the merest novice. This applies to the "Taube" type of German monoplanes, of which we have heard so much. These Taube or "dove" winged machines—ironic designation for an instrument of war—are what may be termed a generic type. There are a dozen or more German makers who, so as to impart inherent stability to a machine, adopt this system of the bird-shaped wing; and all these craft, though they differ materially in detail, have been grouped under the heading of "Taube." There is one advantage of the Taube machine—from our point of view, at any rate; and it is that, when seen against the sky by a firing party, there is no confusing it with any other craft. There are certain German biplanes, with arrow-shaped wings, which may be distinguished with ease. But, apart from these types, there are a large number of machines, both biplanes and monoplanes, that it needs an expert to identify when in flight. There are, as has been said, signs on the wings and tails that are intended to distinguish them; and an officer who has glasses may see these marks, even when a machine is at 3,000 or 4,000 feet—if the air is clear, that is to say. When it is misty, or the aeroplane is very high, then doubt is inevitable. The German air corps, as a distinguishing mark, has adopted a black cross on a grey ground, which is painted on each wing and on the rudder. The French

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machines have a tricolour disc, placed under each wing ; while the British craft, which were identified during the early stages of the war by a Union Jack, painted also under the wings, adopted afterwards the same distinguishing mark as their Allies—the tricolour disc.

## IV

### THE VULNERABILITY OF AEROPLANES

*"It is simply loathly, under fire, to go up as a passenger."*—A BRITISH OFFICER OBSERVER.

APART from jests at the expense of "Archibald," the German anti-aircraft gun which has fired at them painstakingly from week after week, our aviators have extracted humour from every situation, no matter how grim ; and in this spirit of gaiety they have been well supported by the French. Soon after the outbreak of war, the pilots who were scouting devised a game ; and this was to examine their machines each evening, after the adventures of the day, and count each bullet-hole they found in the planes. As these perforations were checked, a chalk mark in red was placed round them, in order that they should not be included in the next day's total. So, from day to day, a table of hits was compiled. The record, for a single day's flying, was claimed by a Frenchman. His machine, in one journey above the German lines, was found to have been pierced by thirty-seven bullets !

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It may be wondered that, when hit so often, a machine should be able to continue in flight. But the puncturing of its wings—which form of course the largest target for gun-fire—has practically no effect upon it. Mr. B. C. Hucks, while on service at the front, had the base of a shrapnel shell drive through the lower plane of the craft he was flying ; thence it embedded itself in the fuselage just in front of him. But the machine remained controllable, and he returned to his starting-point. Describing this adventure in a letter to a friend—as quoted by *The Aeroplane*—Mr. Hucks wrote :—

“ We were heading into a strong wind, blowing I should think between fifty and sixty miles an hour, at a height of 6,000 feet above the German lines. Consequently we made very little progress, and remained almost stationary. This suited our purpose admirably, as it made our operation of watching our gun-fire easier ; but it also suited the gunners of the German anti-aircraft guns, for they fired on us shell after shell. We stuck on, knowing how difficult it is to hit such a target as an aeroplane, which at 6,000 feet looks a wee speck. I saw and heard the shells bursting round us, and we had just finished observing the last gun fired when—crash, and the left plane opened up and I realized we had been hit. A hole big enough to get through, with the torn fabric flapping away in the wind, was altogether too good a reminder of the situation.

“ My feelings under these conditions can better be imagined than described, as the horrid uncertainty of the real extent of the damage, and

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the consequent expectancy of the whole machine crumpling up, gave me a somewhat anxious time in getting to earth.

“ However, I managed to get back, and found that the machine was so badly damaged that it had to be sent back to the base to be rebuilt. The piece of shell had passed through the plane, carrying away two ribs, a main strut, and petrol pipes, and passed just between my passenger and myself.”

Unless some vital part is struck, a craft will remain aloft. Sometimes, however, as the war has proved, the fabric of a wing may be so torn—say by the splinter of a shell—that a pilot finds the equilibrium of his craft impaired, and is obliged to plane down. The *Paris Journal* publishes a story which, while instructive from this point of view, has the merit also of being dramatic. The pilot concerned, a well-known civilian flyer, had orders to start from Paris one morning at dawn, with a passenger and dispatches, and fly to a destination unnamed in the North of France. “ You must,” he was warned, “ take no risks. If the enemy brings you down you must destroy your dispatches, and the aeroplane as well. If you get through, go at once to the General with your passenger, who will give him a verbal message. Good luck ! ”

The story of the flight is told by the passenger, who said :—

“ While the pilot was inspecting his machine I took my seat, with the dispatches between my



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legs, and a carbine slung along the fuselage on either side. . . . The machine rose. We steered directly north, shaken a little by the wind, which caught us sideways.

"Suddenly the pilot shut off the motor, and nothing was audible except the whistling of the wind through the wires. He turned to me and pointed out some little puffs of smoke far below. He signed to me to listen, but I could hear nothing except the sound of the wind. Then the motor was started again, and its steady roar covered everything.

"The puffs grew nearer and more numerous. We tried to rise still higher, when a gust threw us on one side. The pilot righted us, but another and more terrible shock hurled us vertically upwards. Then we began to fall. The smoke and flames were now quite near us, and we were thrown in all directions by great blasts of air.

"Still we flew ahead. Gripping the fuselage, I awaited the end, incapable of thought. Then suddenly calm was restored. We had passed the danger zone, and beneath us was a great forest cut here and there with ravines.

"Hardly had we recovered our feeling of security when danger reappeared. Our aeroplane began to heel over. The pilot shut off the motor, and turning his head, looked towards our left wing, where a strip of torn fabric was streaming in the wind.

"At once a headlong descent began, ending with an abrupt landing in a narrow clearing. Only this pilot could have achieved so desperate a manœuvre. Calmly he jumped to earth, shouting—

" 'Take your carbine while I repair the cloth' ; and then he set to work to patch the torn wing.

" 'If the Boches come,' he added, 'fire at

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them, and I will burn the machine, and we will run for it.'

"While I watched, the pilot continued his work. At last he told me to lift the tail of the machine, started to pull himself, and we bent double with our efforts to drag it to the other end of the clearing. But the roots and stones impeded, and we were about to abandon our task when suddenly the pilot leaped forward and thrust his revolver into the face of an unkempt, dirty man, who had approached unseen. I seized my carbine, but the man stood with his hands in his pockets and said :

" 'We belong to you ; we were ready to guide our men through the forest. When the Boches arrived we hid. My friends are near, and we will help.'

"He called, and a number of equally unkempt peasants stood round the aeroplane. In an instant we were ready to go. The propeller was started and we rose, but the trees opposite came towards us at a great pace, and their height appeared to grow as we approached ; it seemed that we could never rise over them.

"Suddenly, with a bound that put us almost vertical, we passed above them, and were once again looking down on the tree-tops. At the edge of the forest smoke puffs re-appeared ; but a turn enabled us to regain the cover of the forest and to gain altitude. When we came out again, lost in the sky, the guns had ceased, and, descending slowly, we landed in the French lines."

How a biplane was so damaged by gun-fire that the airman almost lost control over it, yet was able to make a landing without losing his life, has been told in the *Berliner Tageblatt*. The pilot, a

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German officer, was above the lines of the Allies, flying with an observer, when his machine was struck by a shell. He says :—

“ A whity-yellow flame flashed before me. The biplane trembled. And at the same moment my passenger fell back, blood flowing from his shoulder. The struts between the planes on the left of the machine had been shot to pieces, and the propeller damaged. The craft began to fall. But, by exerting all my skill, I managed to steer so that we descended upon a wood instead of upon the ground. The impact of the machine split and crushed the tops of the trees ; but the shock of our fall was partly broken. I was violently shaken, however, and lost consciousness. When I came to myself again, I saw my passenger lying on the ground, surrounded by German soldiers. An advance guard of our troops, seeing that the falling biplane was a German machine, had pressed forward to rescue us.”

More than once during the war it has been the cleverness of the aviator, and nothing else, that has brought back a crippled machine to Headquarters. An instance of such skill, which has also a spice of humour, occurred during the operations in France, at a time when the Germans had begun to give ground. One of our pilots took up with him on an observation flight a Staff officer, whose knowledge of aircraft was small. They reached the position to be reconnoitred ; but before any scouting could be done, and while the craft was on the fringe of the enemy's lines, a chance shot from the ground, striking one end

## The Vulnerability of Aeroplanes

of a main-wing, smashed the aileron, or balancing plane, by which sideways stability is maintained. The pilot realized, of course, the gravity of this injury ; but his passenger did not. The former, by dexterous flying, managed to swing his craft round ; then he made his way back towards his starting-point, having to use his rudder as best he could to prevent the machine from heeling over. At length, disaster being averted by personal skill, the aviator made his landing, and turned to his passenger with a smile of relief.

But the latter sprang from the machine with an expression of anger. Then, without a word to the man who had brought him safely to earth, he hastened to Headquarters, and reported the pilot to his Commanding Officer for cowardice in the face of the enemy. He laboured under a complete delusion. Knowing nothing of aeroplane construction, and not realizing that a machine becomes almost uncontrollable when injured as this one had been, he imagined that the pilot, when subjected suddenly to the German fire, had begun to suffer from what aviators call "cold feet," and had turned back deliberately, without proper reason, so as to reach a place of safety.

There were explanations ; it was pointed out to the misguided officer that, far from failing to show a proper spirit, the pilot had used exceptional skill, and that it was nothing but his judgment that had brought them back alive. Then there was an apology—handsomely made—and material as well for a laugh.

## DRAMAS OF THE AIR

*"I think they're pretty sure to bring one of us down sooner or later ; it's really only a matter of time."*

A BRITISH MILITARY PILOT.

THOUGH it is inevitable, seeing they are fired at persistently, that a certain number of aeroplanes should be crippled and forced to descend, an astonishing fact has been the number of hits gunners have been able to register, and yet not cause a pilot to end his flight. Here, for example, is a typical experience, as described by an officer in our Flying Corps—

"On my last flight with — we were shelled and shot at about a hundred times, but only thirteen shots went through the planes, and fortunately neither of us was touched. . . . We have been shot at and shelled, by friends and enemies, every time we have been up, and machines have scarcely ever come down without bullet holes all over the planes."

Another experience, recorded by a British pilot, is also typical. He is writing of a flight over the enemy's lines :—

"Just after this, they got on to us with anti-aircraft guns, and burst shells all round us. We

## Dramas of the Air

got off with nothing worse than a small splinter through the elevator. . . . Fellows have had shells burst all round them, for quite a long time, without being hurt at all."

The factor in the aviator's favour, as revealed conclusively by the war, is that unless the gunners can place a shot in what may be called the vitals of his machine—in motor, fuel-tanks, or radiator—or can break some guiding plane or cut a control wire, or wound or kill the pilot as he sits at his levers, the shells and volleys have small effect. Had it been otherwise, had one shot that struck a craft brought it instantly to earth, the story of aircraft in the war would have been different.

Should a machine be flying low, as it may often need to do, it is by no means difficult, particularly with rifle-fire, to place shots through its planes. But it is one thing to hit the target that these widespread wings afford, and another to strike the hull, with its mechanism and human control.

There is a curious point in this regard. It was reckoned at one time, was considered indeed beyond question, that the propeller of an aeroplane, revolving at high speed, and offering a comparatively large target, would be specially vulnerable—particularly when it is remembered that propellers are built of nothing more shot-resisting than wood. It was thought that, when struck by bullets, a propeller would splinter and fly to fragments owing to centrifugal force. But,

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tests being made, surprising results were obtained. Propellers were set in motion and fired at with rifles ; and it was found that, contrary to expectation, they could be hit many times and yet continue to do their work. All that happened was that each bullet drilled a hole through the blade it struck, and the propeller continued to turn. This knowledge was important : it meant that, for service in actual war, the aeroplane was less vulnerable than had been imagined.

The pilot, naturally, offers a mark. If he is hit, and hit badly, and is flying alone in a machine, there is nothing to save him from death and his machine from destruction. But if there are two men in the aeroplane—a pilot and observer—and should the latter know how to handle a craft, then, even if the pilot is killed or wounded, his companion may be able to bring the machine to earth. A story to illustrate this—one of the most dramatic told—describes the bringing down by the French of a German aeroplane, in which were flying an officer and an observer. It is the latter who speaks :—

“ On the morning of August 22nd I flew in foggy weather to Sedan with Lieutenant ——. We encountered heavy rain, and had to descend to 3,000 feet. As we came down we heard the rattle of the enemy's shrapnel round the machine, and presently a French division came into view beneath.

## Dramas of the Air

"Lieutenant — was shot through the body. Then the motor stopped and the machine glided down steeply, straight at the enemy's troops, which were firing at us. At 2,500 feet from the ground the machine suddenly reared up ; and, turning round, I saw Lieutenant — lying dead with a bullet hole in his forehead.

"I promptly leaned over his seat and gripped the steering-wheel, and was able to start our biplane gliding again. A wood on the other side of the French was my objective. The minutes in which I soared over the enemy, only 600 feet from the ground, seemed centuries to me. A hail of bullets whistled about my ears.

"Suddenly I received a heavy blow on the forehead, and blood rushed into both my eyes. But my will-power conquered. I kept consciousness, and thought only of bringing the machine safely to the ground, away from the enemy.

"Then a sudden puff of wind turned the machine over, and as my dead comrade lay upon the warping-gear I could do nothing but land in the midst of the enemy. In alighting the machine turned over and ran into a hedge. I was sent flying.

"From all sides the French rushed at me, firing still. I drew my pistol and shot three of them, and then I felt a bayonet at my breast. An officer appeared and shouted—

" ' Don't kill him. He's a brave man ! ' "

It is difficult to imagine a tale more thrilling, or more simply told. Of course, it is no more than the old hazard of life and death, such as men have taken and will continue to take on land or sea ; and yet there is added a new and



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a terrible risk : this risk of the air, with aching voids below a craft, and with each aspect of tragedy intensified—because when a man falls forward in his seat shot, or a controlling-plane is' shattered and a machine reels helpless, there is nothing to hope for and nothing to be done—nothing, in fact, save a silent rush through empty air : silent, that is to say, but for the wail of the wind through struts and wires ; and then the rending crash in field, road, or wood ; and a heavier and more complete silence.

## VI

### DUAL-CONTROL MACHINES

*"The aerial scout . . . should learn to combine caution with boldness."*

MAJOR-GENERAL SIR DAVID HENDERSON.

IT is established as a rule that the observer who ascends with a pilot, when on a scouting flight, should be able to control a machine. Sometimes the rule may need to be broken; but it is a rule none the less. Another excellent precaution is that, whenever possible, a two-seated aeroplane should be fitted with dual control. When two men are seated in an aeroplane it is extremely difficult, and in some cases impossible, for either of them to move about in the machine. In many craft, particularly in those intended for high speed, the hull is built narrow, smooth, and tube-like, and the positions of its occupants are represented by circular and separate apertures, into which the men lower themselves, leaving nothing more than their heads above the surface. In such machines, should the pilot be struck by a bullet and rendered helpless, the passenger cannot move into his seat so as to take charge of the machine. What can be done,

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although it entails extra weight, is to equip both pilot and observer with a method of control. In front of the pilot is placed steering-wheel and rudder-bar, and a precisely similar gear is fitted for the observer. So if the pilot is unlucky, and a bullet finds him, the observer can grasp his own controlling-gear, and either continue to fly ahead or plane to some landing-ground. It is necessary, when fitting dual control to a machine, to ensure that, by the use of a simple disconnecting mechanism, each set of levers can be worked independently of the other. A pilot, when killed or wounded, may fall forward in his seat, the weight of his body pressing upon the controls; and in such a case, if the passenger's controlling gear works in conjunction with that of the pilot, and cannot be disconnected from it, he may find it impossible to move his levers.

Our official "Eye-witness," who has told us much that is of interest concerning the operations, describes an incident which shows the value of dual control, and proves that it is worth while, at any rate in war, to carry the extra weight that such a system involves. He writes :—

"A German aeroplane flew high over the interior of our lines, but drew a general fusillade from below, with the result that the pilot was killed outright and the observer wounded. By the aid of dual control, however, the latter continued his flight for some miles. He was then forced to descend by a hit in his petrol-tank, and was captured by the French."

## Dual-Control Machines

In this case, had there not been dual control, it may be assumed that both men would have been killed. Of course when a pilot flies alone, as he has often to do, and is wounded by gunfire, he must rely upon his own fortitude and skill. It has happened more than once that, overcome by weakness before he can regain his starting-point, a wounded pilot has been forced to land; but it is not often that this has resulted in so dramatic an incident as is told below. The story concerns M. Reymond, a Senator of the Loire. In addition to being a skilled airman he was a doctor, and held the rank of a surgeon-major in the French Army. At the outbreak of the war, so eager was he to fly, that he insisted upon being attached to the Aviation Corps. He made a valuable scouting flight one day, and was returning towards the French lines, when he was struck by a bullet. What happened afterwards was told by a Paris correspondent of *The Daily Telegraph* :—

“ He made a desperate effort to regain the French camp; but, his strength failing, the machine fell at an equal distance between the two opposing armies. The result was a fierce combat for the possession of the fallen aeroplane and the fallen aviator.

“ In the struggle the French were finally successful, and Senator Reymond was carried back to the French lines, where he had still the strength to furnish to his superiors a detailed and precise report, which proved of the utmost value. Senator Reymond died a few hours later, but not before

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the General commanding his Division had pinned the Cross of the Legion of Honour on his breast."

One is reminded by this story of the experience that befell one of those wanderers, newspaper correspondents and others, who have haunted the fringes of the battlefields. Following in the wake of the Allies, he was passing through a district where, only a day or so before, there had been furious fighting. Presently he was attracted by something he saw in a field on his left, just clear of the road ; and he walked over to investigate. It was a small, hastily reared mound, topped by a little cross of wood, roughly nailed together ; and on this cross had been written, as legibly as was possible with a pencil, and with little time for the task :—

" Here lies an airman."

That was all, save that not far away, adding poignancy to the lonely grave, there lay the fragments of an aeroplane.

Yet listen to the words of a British pilot, returning from a flight in which he has been sniped at by sharpshooters and blazed at by artillery. He clammers out of his machine, a little breathless but with a cheerful smile.

" This," he says, completely without affectation, " is what I call sport."

Peril means nothing to such men as these. They are invincible, because their sense of humour never deserts them, because they refuse

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to believe they have nerves. It was such a man who, returning from a flight that had taken him through the danger-zone, declared with a solemn zest he had discovered an amusement that would save him from boredom when on a long flight. He went on to explain :—

“ I was at about 7,000 feet when I noticed some small black object quite close to my head. I thought it must be a fly or some insect of that kind ; and yet I was surprised to see one at such a height. At any rate, I stretched out my hand ; and what do you think I found I had caught hold of ? A rifle-bullet ! ”

At this stage, naturally, his hearers interrupted him with expressions of incredulity. He was in no way nonplussed, proceeding to explain, still with gravity, that this bullet was obviously one which had been fired almost vertically into the air ; that it had ascended to its greatest altitude, and then, its momentum gone, had stood still just for an instant before turning over and falling earthward.

“ And it was just at this moment,” he added briskly, “ that I happened to come along in the machine and catch hold of it.”

## VII

### THE ANTI-AIRCRAFT GUNS

*"It's a lucky thing for us these beggars aren't good 'game' shots."*—A BRITISH PILOT.

"ARCHIBALD" we have heard of—the German gun; it was he, one may remember, who shoots well on some days and "damn badly" on others. But he is not alone in his efforts to end the careers of our airmen. According to one of our pilots, writing still in jesting vein—

"He has a big brother named 'Cuthbert,' who is a large howitzer. Cuthbert's first shot is good, but the remainder always miles behind."

Why these instruments of death should have been nicknamed "Archibald" and "Cuthbert" has not transpired; but the spirit, of course, is one of whimsical humour. At the beginning of the war, "Archibald" made uneven practice; those who handled him had everything to learn. They had fired at aeroplanes in theory, but never in actual war; and they found that between theory and practice there lay wide discrepancies. But "Archibald" was

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handled industriously, as is the German way ; and a feature of his work, and one that has rendered him specially dangerous, is that his firing is semi-automatic. A pilot who has provided him with a target remarks :—

“ He has a very distinctive way of firing at you. He'll let off one shell, just to see where it bursts, and find his range by it, and then let off six—one after another.”

The shells fired by this gun are shrapnel ; they are filled, that is to say, with a large number of round bullets, about the size of marbles, which fly out when the shell bursts, and spread over a wide area ; and this moment of bursting is controlled by the gunner by means of a fuse, his desire being to explode the shell as near the aeroplane as possible. In order to do this, he has to gauge the height of the machine from the ground, also the speed at which it flies ; and here lie his difficulties. But they are difficulties which, as has been shown, constant practice will help to overcome. When he has become accustomed to the types of craft used by the enemy, a gunner can estimate with some accuracy their speed in flight, while his range-finding for altitude will improve, naturally, according to the shooting he obtains. That these anti-aircraft guns are formidable weapons may be gathered from the fact that one of them, as used by the Germans, will throw a 20-lb. shrapnel shell to a height considerably



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in excess of that at which, when he is on reconnaissance, an aviator will need to fly. Our army has employed a very handy gun, mounted on a motor-lorry, which fires a 13-lb. shrapnel shell. We have used also a small quick-firing gun, of the "pom-pom" type, such as attracted attention during the South African war. This throws a stream of 1-lb. shells, which are explosive.

One method of range-finding, as employed by the Germans, is ingenious. In the test shell discharged against the aeroplane there is a parachute. When the shell bursts, this parachute floats out in the air and remains for a while a conspicuous mark, giving the gunner time, before it drifts away, to make any correction that may be necessary in the timing of his fuse. Another method is described thus:—

"The anti-aircraft guns are arranged in a triangular formation and, when a hostile machine appears above, one of the gunners—stationed at one point of the triangle—fires a shell which bursts in a red cloud of smoke, and may have fallen short. A second gunner, however, at another point of the triangle, who has been watching this shell, and has seen that the range is too short, aims a hundred feet or so higher; and his shell, to distinguish it from the first, gives off a cloud of black smoke. But perhaps his shot, although the altitude has been corrected, is too much to one side. Whereupon a third gunner, hastening to fire, is able to place a shell nearer to the aeroplane than either of the other two. Perhaps, even, if luck is with him, he may actually strike it with some of the shrapnel shot.

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Success in this system depends largely upon the aeroplane maintaining, while it is under fire, a certain definite height, and flying in the same direction. But a pilot is unwilling to oblige the gunners in either of these respects. His desire is to make himself as elusive and as troublesome a target as he can. Immediately he sees he is under fire he makes wide and erratic sweeps, and constantly alters the height at which he flies. Shells may reach the right altitude, and burst in the right place, but the drawback from the gunner's point of view is that, by the time his weapon has been aimed and the missile has risen skyward, the aeroplane has moved to a different position. A high-speed scout, travelling at 120 miles an hour, covers in each second a distance of more than 170 feet, while a projectile from the ground, fired at such a craft when it is 6,000 feet high, takes several seconds to reach this altitude. To aim directly at the machine, therefore, is hopeless. The gunner must point his weapon, at the moment of firing, at a point some distance in advance of the aeroplane ; and this precise point, unless he knows the speed of the craft, can be found only by trial and error.

A typical German gunner is a man of method and of a certain deliberation—scarcely the man, perhaps, by reason of his temperament, for shooting aeroplanes on the wing. Still, in spite of difficulties and disappointments, " Archibald " has done his best ; and he has certainly made

## Aircraft in the Great War

himself unpleasant, as the following note, written by a British pilot, goes to show :—

“ We were up at Valenciennes. . . . Suddenly I saw five or six thick white puffs of smoke beneath us, which were shells bursting. The next time they made a better shot, and were on the same level, but to the left—and so on. At one time we had eight shells bursting round us at once. Another machine was about a thousand feet above us, and when we got back the people in it told me they really thought we were going to be ‘ done in ’ that time.”

This same aviator, treating “ Archibald’s ” pyrotechnics with an amused contempt, carried up a camera with him one day, and, waiting patiently until a number of shells were rattling as usual all around him, took snapshots of them as they burst.

Occasionally it has happened that the occupants of an aeroplane, emboldened by the fact that they have a machine-gun, have flown deliberately towards the gunners firing at them, and turned the tables by silencing them with a stream of bullets from the air. Attacked near Bruges by an armoured motor-car which contained an anti-aircraft gun, the French biplane threatened, instead of rising towards safety, made a sudden and unexpected swoop, distracting the aim of the gunner in the car and escaping easily the shells he was sending skyward. Then, while sweeping low towards the car at high speed, the passenger in the aeroplane opened fire with his

## The Anti-Aircraft Guns

machine-gun. Those in the motor-car, taken aback by these tactics, and with no armouring to protect them from bullets which came from above, replied for a moment or two with a scattered rifle-fire; then they sprang from the car and made a rush for some neighbouring trees. But two of their number were killed before they reached them, and two wounded. The aeroplane, unscathed, continued its flight.

## VIII

### AIR DISTURBANCE CAUSED BY SHELLS

*"If you come in range of these guns, and you're  
below 6,000 feet, you've one foot in the grave."*

A FRENCH MILITARY PILOT.

AN interesting problem, one discussed keenly before the war, concerns the effect on the stability of an aeroplane of a shell bursting in its vicinity ; it being held that, even though a craft might not be hit either by bullets or splinters, it might be so tossed about, by the air-blast which follows the bursting of a shell, that it would pass beyond control. At one time this theory was thought to be important. It was reckoned that more aeroplanes would be blown down than were actually hit. But this was in the days before machines were, by the science of their construction, given an inherent stability ; also before, in displays of " looping " and upside-down flying, pilots had shown that, granted they were sufficiently high, they could recover a well-built machine from practically any position into which it might be thrown.

## Air Disturbance caused by Shells

So far, in tidings from the front, this question of air disturbance has been rarely mentioned ; but in one report, emanating from French sources, and describing a flight near Longwy by a pilot and passenger in a biplane, it is explained that the machine came suddenly under fire, and that "one shell burst so near it that the machine was thrown completely off its balance." But there was no disaster. The biplane side-slipped, it is true, and its fall was checked only when dangerously near the ground ; but the airman managed to make a safe landing, none the less. The fact that he could do this, that he could restore the balance of an overturned craft, is one of the most vital in the science of aviation. When a machine does overturn, when it is thrown completely from its equilibrium, there is no need for a pilot to despair. The only factor he needs in his favour is altitude. If an aircraft overturns, it will fall almost vertically a certain distance ; and during this fall it is beyond control. But there comes a moment when, having gained a certain critical speed, and owing to the shaping and placing of its wings, and the disposition of the weights it carries, the inherent stability of the machine begins to play its part. Automatically it recovers from the dive ; its descent is checked ; and it moves forward again in normal flight. This recovery is not accidental ; with a properly designed machine it is as certain to take place as is the recovery of a lifeboat when overturned

## Aircraft in the Great War

by a wave. But height is essential. Should the pilot be flying low, and his machine side-slip, it may crash to earth before its inherent stability has had time to exert itself.

That atmospheric disturbances through shell fire may become unpleasant, even if not actually perilous, can be judged from the statement of a British pilot who, when interviewed by a special correspondent of *The Standard*, said :—

“ A fight with an enemy's aeroplane is fine sport, and the Germans cannot beat us at that. But when they get their high-angle guns at work on us, the disturbance of the air is so great that it is as much as ever you can do to control your machine. It plunges up and down and rolls sideways, so that, do what you will, it nearly turns over. You hardly know whether you are upside down or not. I have been in plenty of bad weather at sea, and it is worse than anything I ever suffered in a boat. It makes me downright sick—just like a bad attack of sea-sickness.”

That there is a distinctive form of nausea, corresponding to sea-sickness, which may be caused by the rocking of an aircraft, is an established fact. More than one pilot, when taking part in an air-race, has been compelled to descend merely because he has become unwell. That there should be this air-sickness is not surprising when it is remembered that a craft, if it meets a heavy squall of wind, may rear suddenly or dive many feet, or swing over until it skids sideways like a motor-car on a greasy road.

## IX

### THE FAILURE OF ARTILLERY

*"The German anti-aircraft guns have been unusually active . . . but they have not had much effect in reducing the air reconnaissances carried out by us."*

BRITISH HEADQUARTERS REPORT.

THE problem of gunfire and the aeroplane, as revealed by the war, resolves itself to this : the artillery has attempted to check aircraft and has been unable to do so, and the immunity of the flying-scouts has been due to the fact that, for the purposes of this campaign, they represent a more perfect weapon than do the guns which combat them.

Reliable statistics are not obtainable as to casualties among the Flying Corps. But it is known that Germany, in the earliest phase of the war, lost seventeen of her aviators ; these were actually killed. Five German aircraft were, in the fighting near Mons, brought down by the British. At the end of October, according to the *Paris Journal*, there had been fifty German pilots killed, and a hundred aeroplanes destroyed. Our losses were slight ; they numbered only half a dozen even by December ; but the casualties



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among our craft, in accidents and damage by gunfire, were certainly heavy. French casualties, so far as can be gathered, were not large. From the beginning of the war, until mid-December, she had lost between twenty and thirty of her aviators, who were reported either killed or missing.

One must remember that the flying services are small. The air-scouts in this war, those employed on all sides, form an infinitesimal part of the total forces engaged. A fact that emerges is this: the aviators fly out, and though some of the machines are winged, there are many which return; and as war is war, and risk of life or death forms part of the day's routine, these machines that are wrecked, and these men who are killed, spell merely the price that has been paid, and will continue to be paid, for such priceless intelligence as an air service alone can glean.

**PART FOUR**

**THE “EYES” OF AN ARMY:  
WHAT THEY SEE**



# I

## A SUPER-SCOUT

*"The most difficult thing is to discover the enemy's plans, and detect the truth in all the reports one receives."*—NAPOLEON.

THE aeroplane, as an instrument of war, has shown in this campaign a peculiar adaptability. It has been used for scouting, and, when necessary, as a weapon of destruction ; it has been employed to direct the fire of artillery ; and it has done valuable work also as a dispatch-carrier, or as a means of transport for Staff officers when they have needed to reach quickly some distant battle-front. But its supreme task—the work that has influenced the whole tenor of the campaign—has been as a scout.

In British official statements, issued from time to time during the war, this main purpose of the aeroplane has been outlined clearly ; and one needs rather to labour the point for the reason that, although bombs have been dropped from machines, and aerial duels fought, it is as a scout that the modern aircraft does its really vital work. Aviation is in its infancy ; the aeroplane of to-

## Aircraft in the Great War

day, surprising though its flights may be, is a crude and imperfect craft. Had war come five years later, we might have told a different tale. Then, without doubt, there would have been a specially devised fighting machine ; another, too, for the accurate dropping of bombs. But as it is, and with craft available, fighting and bomb-dropping have been haphazard, relying for success not on mechanical aids, but on the skill and daring of the men concerned.

As a scout, thanks to improvements in construction, and to the concentration of engineers on this one type of craft, the war found available a machine which, flying in all weathers and for hours on end, recalls the prediction made, more than four years ago, by a military correspondent of *The Times*. After watching a first and tentative use of aircraft in the French manœuvres in Picardy, he wrote :—

“ In my belief the aeroplane, given a trained pilot and a skilled observer, must revolutionize the whole service of reconnaissance.”

That prophecy has been to a great extent fulfilled ; although cavalry scouts still do work that is of importance, and render many services for which the aeroplane is unsuited. In a flight of less than three hours, during this campaign, air-scouts have been able to visit a locality that is three days' march away, observe the enemy occupying it, and return to their headquarters.

## II

### PREPARING FOR A FLIGHT

*"The main object of military aviation is the collection of information."*

BRITISH HEADQUARTERS REPORT.

DEFINITELY outlined, in official statements and elsewhere, is the chief task of the aviator in war. He may fight sometimes; upon occasion he may drop bombs; but essentially he is the scout—augmenting the work of the cavalry, and doing work they cannot do.

To understand a pilot's difficulties, and the conditions under which he does his work, it is necessary to picture him as he sets out for a flight in his machine—either alone if it is a rapid survey, or with an observer should the report required be detailed. The airman climbs into his driving-seat. He is quite comfortable—sitting low and snug within the hull. His seat is padded, and he is protected more or less from the rush of wind; though round his head, as he peers in front of him, there is the roar of the gale that tells the speed of his flight. He shields his eyes with goggles, and wears a woollen cap or

## Aircraft in the Great War

helmet ; while an up-tilted section of the hull before him, acting like the screen of a motor-car, will deflect from his face the worst of the rush of wind.

Placed in front of the pilot, as he sits in his driving-seat, is an instrument-board which contains dials and gauges. There are certain things he must know while he is flying, and he can learn them only by a study of these dials. He needs to know that his engine is running smoothly. His ear, when trained, will tell him of any sudden falter ; but an instrument is also provided which informs him, with an accuracy impossible by other means, how many revolutions per minute his motor is making. This dial he watches from time to time. He may have an engine, for example, which delivers power to fly his machine when it is turning at from 1,200 to 1,300 revolutions a minute. So long, therefore, as the needle on his dial registers this rate of speed, and does so without fluctuation, there is no need to concern himself about any loss of flying speed. An aeroplane maintains itself aloft merely by the speed at which he flies. If a motor should flag, and if the pilot is not aware of the fact instantly, his craft may lose altitude ; then, should he force it to climb with insufficient power, it may come to a standstill in the air and slip sideways or fall tail-first.

The pilot needs also to note—apart from the evidence his eyes provide—what height he is above the ground. He has an altitude meter ;

## Preparing for a Flight

and at this, as he flies, he glances from time to time. For military flying, and in war, the question of height is naturally all-important ; it may spell the difference between life and death. In this regard one is reminded of the answer of a British airman who, when asked at what height he flew when passing above gunfire, retorted with humorous brevity—

“ Just as high as I jolly well can.”



### III

## THE CONTROL OF A MACHINE

*"I have not a thought outside the business in hand."*

THE ESSAYS OF AN AVIATOR.

ON modern machines—a refinement provided recently by science—there is an indicator which tells a pilot his speed through the air ; and this has proved very useful. There is another gauge, too, although it is not always fitted, which shows the angle at which a machine ascends when it is leaving the ground, or at which it passes through the air after gaining its required altitude. This instrument acts as a safeguard. If a machine is forced up at too steep an angle, or is allowed to fly with its tail depressed, it may become " stalled " in the air, as the expression goes ; this means that it may lose forward speed, and slide backwards.

Other fittings that are indispensable are a map and compass ; with both, of course, the military airman is provided. His compass is placed where he can keep his eye on it, while his map is clipped in a frame just in front of his driving-seat. In the early days of aviation, much to the

## The Control of a Machine

confusion of pilots, the compasses fitted to aeroplanes were unreliable. Vibration affected them ; so did the presence, near them, of such a mass of metal as was represented by the motor and its gear. But science has overcome this. Special compasses are made for flying which resist vibration ; their needles are compensated against the attraction of metal near them ; while any rod or bar—such as a steering column—which must of necessity be placed in their proximity, is constructed of some metal that is non-magnetic. The pilot to-day may rely on his compass, and does not find himself in the predicament of one of the pioneer airmen who, when flying across Channel and with a sea-mist to perplex him, looked to his compass needle for guidance, and found it would do nothing but spin slowly round and round !

Immediately in front of an aviator, as he takes his seat, is an upright lever which projects from the floor-boards of the hull. This rod, when drawn backward, moves the lifting planes of the aircraft and causes it to ascend ; and when it is pushed forward the machine descends. Moved sideways, either right or left, as need may arise through the influence of a gust, the rod actuates the “ailerons,” or balancing planes, which are fitted to the rear extremities of the main-planes of many craft, and causes a machine to recover itself, should it heel over laterally and threaten to lose equilibrium. As an alternative to the aileron, for lateral control, the rear ex-

## Aircraft in the Great War

tremities of the planes can be rendered flexible, so that—by the action of suitable wires—they may be drawn up and down, or “warped,” as it is called, and a similar effect obtained to that of the aileron.

What a pilot does, while flying, is much what one sees a motor driver do as he steers his car. He makes small and constant movements of the steering column—now an inch or so sideways; then a fraction forward; then, again, a slight pull back. “Feeling” the control, it is called; and the motorist, as he holds his steering-wheel, makes constantly these small and seemingly purposeless movements. What they do is to preserve continuously, and in the only way possible, the connection between the human brain and hands and the mechanism by which this controlling power operates. The motor-car driver, by his constant pulls on the steering-wheel, makes himself one with his machine: brain, hands, and wheel are in ceaseless accord; and the airman, as he works at his control rod—like a rider who has good hands will draw on the bit in his horse’s mouth—establishes a link of sensitive feeling between himself and his craft. He anticipates, so to say, its movements; is ready instantly, with a suitable action, for any dive or swing that may follow a sudden gust. It is this delicacy, this sureness of touch, that makes an expert pilot. Of the late Hubert Latham it used to be said his sensitiveness was so great that, almost before a wind-

## The Control of a Machine

gust could bear upon him, he had prepared his craft to meet it.

Apart from his work at the steering column, the pilot rests his feet when in flight on a rudder-bar; and this, as he rocks it to and fro on a central pivot, causes the rudder at the rear of his machine to swing, and inclines the craft from side to side—in the same way as a boat is steered.

Here, then, one has some picture of the aviator as he flies, sitting low in his machine, the control lever before him, his feet on the rudder-bar. Ahead of him, should the machine be a tractor, there is the roar of the engine and the whirl of the propeller, turning so quickly—when the motor is at full speed—that to the eye it becomes invisible.

For a moment or so before leaving ground, after the mechanic has swung the propeller and the cylinders have begun to fire, the airman sits motionless in his seat, listening to the beat of the engine, and satisfying himself that it is working well. Then, as he raises an arm, the men who are holding back the craft step aside. It springs forward, first with its wheels pressing hard upon the turf, then skimming so lightly that they leave no trail. Drawing his lever towards him, the pilot inclines the bow of his machine upward, and leaves earth for air, the transition being so smooth that it is almost imperceptible. And then follows an upward climb, with the earth passing away below as though drawn by an unseen hand.

## IV

### IN THE AIR

*"This is the greatest fun in the world."*

A BRITISH PILOT.

"WHAT is it like to fly?" The question has lost novelty, yet it has never been answered—never, that is to say, in a manner wholly convincing. The reason is that the sensation is indescribable—"like nothing else on earth," as a passenger has said. If you can imagine yourself gliding over a smooth surface of ice, on skates you cannot feel and which make no noise, that may convey some faint idea, perhaps, of the feelings you experience after leaving ground. You are supported on something, yet you are not supported: you look down, and there is nothing below you but an empty void; yet the machine rides firmly and securely, as though you were in a motor-car on the smoothest road.

The pilot, when on a reconnoitring flight in war, has no time for analysing his sensations; he is far too busy. An anonymous aviator, in his essays in *Aeronautics*, has explained:—

"The first ten minutes or so are occupied with getting my height, seeing that all the instruments

## In the Air

are working properly, and listening to the engine. . . . Then my eyes begin an almost ceaseless round of the instruments : aneroid, air-speed indicator, revolution indicator, oil-gauge, petrol-gauge, compass, map, watch. Occasionally I look over the side to see if I am on my course. Occasionally I look about to see if any good fields are near in case the engine should stop and I had to land."

The failure of one's engine when in flight is, even in times of peace, a sufficiently awkward occurrence ; although, thanks to a constant improvement in construction, such breakdowns grow rarer day by day. It was only in 1908, one must remember, that Henry Farman was striving to obtain a motor that would run for five consecutive minutes without breakdown. A risk exists to-day, despite all human care, that some small working part should—just at a critical moment—fail suddenly to do its task. A valve-spring may break, an ignition-wire come adrift, a magneto give trouble, a petrol-pipe shake free, owing to the loosening of a screw-nut from the union that holds it to its tank. As Lieut.-Colonel Sykes puts it : " A little too much trust in Providence is still asked for." Of course the ideal is that, instead of trusting himself to one motor, a pilot should have several in his machine. Then, if one unit fails, he will be able to fly on with the other or others. Machines so built have been flown already, and have emerged from their tests quite well. But

## Aircraft in the Great War

there are problems of weight and power-transmission that remain to be solved; and in this war, remembering that both the aeroplane and its motive plant are experimental, and that simplicity is the aim of all construction, a single-engine craft is considered most practical.

When he is over an enemy's territory, and his motor misfires and then stops, the aviator is in an awkward plight. If he is flying high, and can prolong his glide earthward, and is not far within hostile country, it may just be possible for him to reach a place of safety. The following story, told by the Russian pilot Kusminsky in the *Russ Koye Slavo*, illustrates this point clearly, and is more than a little exciting. Kusminsky says:—

“ I ascended with an officer of the General Staff. First we flew along the front of our own army, then we turned towards the enemy. With us, but in separate machines, ascended two other aviators. Each of us had a different mission, and we soon lost sight of one another.

“ According to the orders of our commander, my officer and I were to keep within view of the highway. We flew very high.

“ When not far from the Russian frontier, and still at a great height, we suddenly heard an explosion, and found that a valve of the motor had broken. . . . I shut off the petrol and switched off. We began to descend in a *vol-plané*, and to avoid capture by the enemy did our utmost to prolong our flight in the direction of the Russian lines.

“ Although we had a very good map, we

## In the Air

could not tell precisely where we were. At last we touched the ground, and saw in the fields not far away a crowd of peasants.

"The officer at once shouted—

" 'Soak the machine with petrol, and get matches ready, so that if they are Austrians we can set the whole thing on fire.'

"But we had no need to do this, for they were Russians.

"We had alighted about three miles within the Russian frontier, and soon a party of our own troops arrived, and took us back to their quarters."

The pilot who suffers from engine failure cannot, however, hope always to be as lucky as this. He may strive to reach his own lines, prolonging his glide to its limit, and yet descend within a danger-zone. Here, as told by the *Echo de Paris*, is an incident that shows this risk :—

"One of our aeroplanes, steered by Captain-aviator Watt, with, as observer, Captain Chapitrel, had engine failure at B——, at a moment when the machine was at a height of 1,800 metres, and at a distance from our trenches of about 5 to 6 kilometres. The aviators landed without accident between the German and French trenches ; but as these trenches were only divided at that point by one hundred metres, they were subjected to the fire of the German infantry and artillery. The aeroplane was destroyed, but the two aviators were able to hide themselves behind a stack of straw ; and they remained in that perilous situation, waiting to regain our trenches. Presently the stack of straw was set on fire.



## Aircraft in the Great War

Then, shielding themselves in the smoke that arose, the two aviators stole away and reached our lines."

On several occasions during the war pilots have been more unfortunate than this: their engines have stopped when they have been far within the enemy's lines, and there has been nothing to do but plane down, trusting to luck and their own resource. Neat ruses have been adopted to escape capture. There is, for instance, a story from an official French communiqué:—

"One of our aviators, running short of petrol, was compelled to land in a village. . . . He was replenishing his reservoir when a strong German patrol was signalled. The officer continued calmly to empty his petrol-tins. The Germans, quite at a loss, halted at a distance of two hundred yards without attempting to fire. Possibly they feared some trap. His reservoir full, the aviator set his motor going and flew away. It was only then that the Germans, seeing that they had been tricked, opened fire upon him, but it was too late. The machine and the pilot returned to their centre safely."

For successful "bluff," however, the palm should go perhaps to a couple of British aviators; and though the trouble in which they found themselves did not arise, as it happened, from the failure of their motor, still the story, which is told by Mr. Grey in *The Aeroplane*, seems most

## In the Air

effective if narrated here. The aviators had been for some time in flight, scouting above the enemy ; and, on their return, they sought to descend in the same field from which they had started. This field, at the time they departed on their flight, was well within the British lines ; but while they were in the air the British had fallen back, and along the fringe of the field now, unseen by the airmen until they had landed, was a line of German troops. The machine planed down ; then, when it seemed too late, its occupants saw the trap into which they had fallen.

As the craft touched ground, still with its motor running, a couple of German officers rode out from the hedge. But the pilot in charge of the machine, a man of resource, opened the throttle of his motor again instantly, and took the machine into the air, flying low near the ground and steering so that he should pass fairly close, and yet not too close, to the German officers. Then, as he swept along near them, he waved a hand in cheerful greeting ; and his passenger, falling in quickly with the scheme, did the same.

The Germans, obviously, were nonplussed. They were not near enough to the machine to be able to identify its occupants ; and it might, of course, be a German craft. It acted, in fact, exactly as though it were. Instead of seeking to escape, or make suspicious evolutions, it flew right along the front of the troops who lined

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the hedge. The two officers watched it with preoccupied frowns. One false move on the pilot's part, and he and his craft would have been riddled with shot. But when he had reached the end of the German line he turned his craft—with the amicable wish, apparently, of giving the soldiers a display—and began to fly back again. He was still quite near the ground, and suggested no idea that he was attempting to get away ; but all the same, though very insidiously, he had widened a little the gap that separated him from the rifles and machine-guns.

Then, as the two officers still sat their horses in the field, eyeing him in perplexity, he began to circle round and round the line of troops, rising very gracefully as he did so, until he was at an altitude of more than a thousand feet. Still the officers refrained from giving an order to fire ; they could not make up their minds as to the strange antics of this machine. Then, quite suddenly, their doubts were set at rest. The aeroplane checked itself abruptly in its circling, hung poised for a moment, and darted away towards the British lines. In fury at being tricked, the German officers shouted to their men to fire. But the hail of bullets came too late. The aeroplane sped out of range.

On another occasion, brought down by the need for a motor adjustment near a cavalry patrol, one of our pilots took these horsemen to be British. Leaving his machine, he walked across a field towards them. But suddenly they

## In the Air

began to ride at him at a gallop. Then he saw his error ; they were Germans. Shouting to his passenger, who had been repairing the defect in the motor, he raced back at top speed to his machine. Luckily the engine was now running, and in a few seconds the pilot was in his seat and the craft in motion, the Germans firing erratically meanwhile as they galloped on. But now the airman was faced by a problem. The field was bounded by a wood ; if he rose into the air in a direction away from the Germans, he would need to pass above the trees. But his eye told him he had not sufficient space for this manœuvre. So he had to make a half-turn, low near the ground, and sweep back directly above his pursuers' heads. Scarcely more than 30 feet high, he passed over them, and they fired at him hotly. But they were mounted and in motion, and their aim was bad. Nearly thirty times the craft was struck, but no vital part was reached ; and the airmen, escaping without a scratch, regained their lines in safety.

Very adroit was the action of a Russian air-scout who, after penetrating hostile country beyond Königsberg, was brought down suddenly by the stoppage of his motor. His exploit is told as follows :—

“ He landed in a German village, and was surrounded by alarmed peasants, to whom he explained in German that the Cossacks were coming, and he had flown ahead to warn the country. A general panic ensued ; but a few

## Aircraft in the Great War

valiant yokels were persuaded to remain and assist the aviator to put things right and start his engine. Then he returned to his own lines, and with some valuable information."

More than once, compelled to descend by engine failure in the enemy's lines, airmen have deserted their machines and crept through lanes and woods in order to avoid hostile patrols. In such cases, if they have not time to destroy their craft, it may fall into the enemy's hands; but occasionally, should the opportunity seem favourable, a dash will be made to recover it. Baron de Caters, a Belgian pilot, effected during the siege of Antwerp a neat coup in this regard. The story is told in an official communiqué :—

"Two Belgian aviators, returning to Headquarters, had to land owing to a breakdown in the neighbourhood of some Uhlans. The airmen found they could not repair the machine; so they slipped away and regained the Belgian lines, and the aeroplane was given up as lost.

"Two days later, however, it was ascertained that it was still at the same place, being guarded by Uhlans.

"A party (and this party was headed by the Baron de Caters) set out at once with an 80 h.-p. motor, which had a quick-firing gun, and to which was attached a trolley. The party came up to the spot at great speed and surprised and drove off the Uhlans, afterwards keeping them at bay with the machine-gun, while the aeroplane was dismantled and packed on the trolley. . . . The convoy then drove off safely under the very noses of the surprised Germans."

## In the Air

Such smart work is not, of course, feasible very often. What the aviators do as a rule, when they have to desert their machines, is to set them on fire.

M. Pégoud, the first aviator to "loop the loop" in public, who has served in the French air corps during the war, tells a story. He had to alight, through lack of petrol, at a point behind the German lines. He managed to conceal his aeroplane temporarily, then moved cautiously towards a village and met some French peasants. They were eager to help him, but could promise him no petrol; the entire stock in the locality had been commandeered by the Germans. But a little peasant boy said he believed some could be obtained at a garage a few miles away, and set off resolutely in quest of it.

" 'It was,' said M. Pégoud to a *Daily Express* correspondent, 'a dangerous journey for the little chap, but he walked out through those German camps with the courage of a saint, and I felt like a coward for letting him go. In the darkness before dawn back he came, tugging a five-litre tin as big almost as himself, and set the precious liquid before me with a smile. Then he hurried away, as he said, 'to keep a watch for Uhlans.' I had no sooner poured the petrol in the tank and dragged my machine into the open than I saw him tearing frantically back. 'Hurry! Uhlans coming!'"

A cavalry patrol of Germans was indeed approaching; but M. Pégoud, ascending rapidly and swerving so as to escape rifle-bullets, managed to make his escape.

## V

### THE FLYING MEN AT WORK

*"The air-scout can see what Wellington always wanted to see—what is on 'the other side of the hill.'"*—MAJOR-GENERAL SIR DAVID HENDERSON.

EVEN when he is over the enemy, and his motor is running well, and the atmosphere is clear and guns thunder in vain, the task of the airman is by no means easy. It is difficult—in some cases extremely difficult—to make accurate observations from the air. Long training and much practice are essential.

When he looks down upon the earth, say from a height of 7,000 or 8,000 feet, an airman sees it spread out like a map—a map raised in a slight relief and made up of various colours: the green of grass fields, the yellow tint of those which stand in corn, the dark patches of the woods, the mirror-like gleam of a lake or river, the white, ribbon-like strips of the roads, and the shine of the metals of a railway, stretching across the country as though ruled by some mighty pen.

If there are troops marching along a road,

## The Flying Men at Work

and it is a dry summer's day, the airman's task is one of no complexity. He looks down from his vantage-point, and sees a low, thick cloud of dust which hangs over the road, twisting and turning here and there. Its density seems never to vary; it looks opaque in the sun, and yet, snake-like, it is creeping slowly forward. This, he knows, means infantry on the march. Far beneath him, in the choking cloud of dust that the pounding of their feet sends upward, march thousands of dirty-faced, dry-tongued men—enveloped chokingly in a dust-stream from which they cannot escape. And perhaps on a parallel road, not far away, the observer will see another cloud of dust, which seems thinner than the first and rises higher. This, experience tells him, is made by the feet of horses as cavalry moves forward. There may be a series of isolated, heavily hanging dust-clouds, dotted here and there along the roads. These mean the passage of the supply-wagons and the guns. So, from this dust picture, the airman deduces the passing, perhaps, of an army corps. He observes carefully, for instance, the length of the dust-clouds and is able in this way to estimate the numbers who may be causing them. Aviators cannot recognize, as a rule, what particular regiments of the enemy may be moving below. They cannot say "That is such-and-such an army corps." And the reason, of course, is that they cannot get near enough to note such details. But this information is required, none the less; and here



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it is that the cavalry scouts augment the work of the aeroplane. Major-General Sir David Henderson, outlining the duties of cavalry scouts, says that they are : (1) to find the enemy's cavalry ; (2) to beat it ; (3) to find the enemy's main bodies ; (4) to keep in touch with them. The first and third of these tasks are, he points out, such as may be undertaken by aeroplane. The point to remember, in any comparison, is that cavalry have the power of action, and of feeling the strength of an enemy ; while the airmen can only watch and report what they have seen. The importance of cavalry reconnaissance is impaired in no way by the introduction of the aeroplane. Ten or fifteen miles ahead of an army, as it advances, is formed the cavalry screen, which seeks to resist the penetration of the enemy, and so prevent him from gauging the strength of the troops behind. And ahead of the cavalry screen are thrown patrols—small parties consisting of seven or eight men, who may extend over twenty or thirty miles of country. In addition to them there may be special patrols, formed by an officer and a handful of men, who will act independently of other bodies in a search for information, and travel perhaps fifty or sixty miles ahead of their own troops.

Air-scouting may prove simple work when conditions are ideal. Against a main road, even when there is no dust, and when they are marching in close formation, a body of troops cannot well be missed. But such easy tasks are not

## The Flying Men at Work

frequently encountered. The enemy, grown wily in this matter of air reconnaissance, has no wish to make things easy for the scout. Everything possible is done, in fact, so as to deceive him. When an aeroplane comes in sight troops will, if there is time to do so, hurry to the nearest cover ; or, if they cannot do this, they are told to draw to the sides of the roads and stand quite still. An object motionless is, of course, far more difficult to observe than one that is moving. But even should a column on the march take cover when an aero-engine is heard, it is not easy for them to hide all traces of their presence. "There is always," as Lieut.-Colonel Sykes explains, "an uneasy look about the road which attracts the attention of a good observer. The tail of a wagon, a deserted cooker, a belated ambulance gives the show away."

Russian troops have a method of marching that has proved perplexing to German air-scouts. They open out upon a road, when on a long march, straggling along in an uneven and undisciplined formation ; and from above, when one of these ragged streams of men is seen, it is extremely difficult to estimate what its numerical strength may be.

When large masses of troops are to be moved, it is done so far as possible by night ; and although the aeroplane can be used also at night, and has been so used, its risks and difficulties are, during the hours of darkness, very materially increased. But land forces have their perplexi-

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ties, too, if they decide to move at night. Prior to any such movement, if it is to be made on a large scale, there must be a collection of vehicles for transport—either motors or trains; and during the daytime, while the troops are waiting for their departure, or are halting on their journey, it is difficult to hide their presence, either in billets or bivouacs. There are tell-tale movements the airman, if he has a trained eye, may see and make deductions from during the hours of daylight. Even if transports are collected many miles to the rear this may not prevent their being seen. The aviator, with no land patrols to check him, can penetrate as far as he likes within the enemy's lines. Hostile aircraft, when they are seen, must be avoided. The airman on a flight like this, using a high-speed craft, is not out to fight, but to spy. It is one of his main tasks, during the progress of any battle, to fly to the rear of the hostile lines and see what, so to say, is being done "behind the scenes."

The work of getting behind the enemy, and seeing what move he may be preparing next, is one of extreme importance; and no machine, save the aeroplane, is able as a rule to accomplish it. Cavalry scouts may, on occasion, be lucky enough to work their way round one of the wings; but their reports, even if they do so, cannot be more than fragmentary: they will lack the scope, and the speed in transmission, that are possible with aircraft.

## The Flying Men at Work

More than once during the war, and notably in the fighting on the Aisne, the air-scouts of the Allies were able, by watching railway centres in the rear of the German lines, to anticipate movements of troops. Once they noted, at several junctions, the bringing together of empty trains ; and this fact, when reported to Headquarters, and dovetailed with other news the Staff had received, led to the checkmating of a heavy attack. Another incident, which helps to make clear this point, was described in *The Daily Telegraph* by Mr. W. T. Massy. The Germans wished to transfer men quickly from one point to another ; and Mr. Massy writes :—

“ Acting on the principle that the longest way round is the shortest journey, they took the troops fully a hundred miles by rail in a semicircular route, hoping thereby to escape the vigilance of the flying-scouts. . . . But if they anticipated that they could move several army corps without the aviators catching sight of them, they were woefully disappointed. The movement was noted before it began.”

Motor-omnibuses have been used largely for the transport of troops, particularly in short movements here and there behind the fighting line. A point which is threatened suddenly may need reinforcing without a moment's delay ; or, should an opportunity present itself, during an action, for some quick and decisive blow, then a body of troops—rushed instantly to

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the spot—may mean all the difference between failure and success. But here again the airmen must be reckoned with. They see these strings of motor-vehicles pouring along a road, and can report so quickly that there is time to frustrate the blow before it is struck.

## VI

### TRICKS TO DECEIVE AVIATORS

*"When a plane is sighted or heard—which latter generally happens first—the look-out shouts and everybody goes to ground."*

AN OFFICER OF ARTILLERY.

INGENUITY is devoted to outwitting the flying-scouts ; and it happens occasionally that they are deceived or puzzled in their work. A ruse of the Germans, which proved so successful that it is likely to become historic, is certainly worth describing. During the fiercest fighting in France, while lines of troops were battering at each other without avail, the Germans were calling up reinforcements. But the airmen of the Allies, having already noted signs of these movements, were keenly on the alert. One day, during a reconnaissance, two German army corps were seen to be marching towards the forest at Vermand ; and it became the duty of the airmen, in this and subsequent flights, to follow the movements of these corps and see at what point they strengthened the German line. One was traced, with complete success. It was seen to move forward until it joined, at St. Quentin, German

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troops which were in action. But in regard to the second of the two corps something mysterious happened. It disappeared suddenly—vanished as though the earth had swallowed it up; and although the aviators searched diligently, and traversed many miles by air, this missing army corps was never seen again. It had not gone back, apparently; nor had it gone forward; and at no point could it be traced as having reached the German front.

The key to the mystery lay in the forest of Vermand. The German Commander, an astute man, had drawn his corps into the heart of the forest; and there they moved, unseen by the airmen above. This was all very well, of course, so long as they remained in the forest; but they were of no value there as a fighting unit. They must, after passing through the forest, emerge from it at some point; and then they would be exposed again and identified. But the German Commander was equal to this emergency. Before his troops reached the fringe of the woods he split them into small parties; and it was arranged that they should leave cover from different points, and at different times, and reassemble again some considerable distance away. This scheme was, as a matter of fact, very neatly carried out. The men stole from the woods here and there, in small parties which were inconspicuous, and none of them caught the eye of the aviators above—who were on the look-out for an army corps, not for straggling bodies of men.

## Tricks to Deceive Aviators

Another trick of the Germans, to baffle our scouts, was ingenious also. A reconnoitring flight had been made, one of several hours' duration ; and the airmen had flown, according to instructions, well to the rear of the German lines. No movements of troops had been detected ; but one fact, none the less, had perplexed them, and they reported it to Headquarters. Moving from the German rear towards the front they had seen an extraordinarily large number of wagons, such as are used for the conveyance of supplies. Such columns are not, in themselves, an uncommon sight ; but what struck the airmen in this instance, and made them mention the point specifically, was the immense number of these wagons, which extended for miles along the roads ; also the unusual pace at which they were being hurried forward. Headquarters was not satisfied with this report ; it aroused its suspicions ; and next morning, immediately it was light enough to see, the airmen were ordered to repeat their flight, and note what had become of these miles of transports. They did so, and the mystery was explained. A large body of German troops had been hidden in the food-wagons ; and, by hastening these vehicles forward during the night, they had reached before dawn a point just behind the fighting line. When the aerial observers reached the scene, the men had been disembarked from their transports and were moving to the trenches. The section of the Allied front that was menaced was not very



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strongly held ; the position therefore was critical. But the air-scouts, flying back instantly, were able to give the alarm in time. Reserves were thrown forward ; they reached our trenches before the attack developed ; and the Germans, sweeping impetuously against what they assumed to be a weakly-held line, were shaken and beaten back by a murderous fire.

## VII

### OUR AIRMEN ABOVE THE GERMAN RIGHT

*"Until one side has inflicted, and the other accepted, defeat, that success which is the object of war has not been achieved."*

MAJOR-GENERAL SIR DAVID HENDERSON.

AT Mons, as we have described, our air-scouts rendered important service. This was in the first stage of the war. And at the beginning of the second phase, only a week or so later, the aviators were able again to do conspicuous work. It will be remembered that General Von Kluck, on the German right, had thrust his way through France, by the weight and violence of his attack, at a speed which astonished the world. The Allies fell back, step by step; but though battered to the point of exhaustion they would not break. It was an army undefeated, instead of one in pell-mell retreat, that Von Kluck found facing him as he drew near Paris; and this did not suit him at all. In German plans, as made before the war, this magnificent rearguard fighting, such as had been waged by the Allies, had

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scarcely been reckoned a factor. Von Kluck had hoped to crush the British, and overwhelm the French. That there should be a hostile army facing him, still intact, as he neared the gates of Paris, was by no means according to plan. But this army refused to be beaten. Give ground it would ; but for every yard it yielded it took its toll of life ; and still it spread an unbroken line of steel. To invest Paris, with a large and mobile army to threaten communications and harass him on his flank, was no policy for Von Kluck ; and so it happened that, at the eleventh hour, and when virtually in sight of his goal, he had to modify his plan and turn aside.

There came a critical moment when the German tide, instead of flowing on towards Paris, began to set eastward ; the aim being to pass across the front of the British, and drive a crushing wedge-like blow into the army of the French. Here was a prime move, a change of plans that had vital import ; and it was vastly to the interests of the German Staff that it should not be detected by their foe—at least, not until the movement was well in progress. So Von Kluck, ere he swung his troops east, threw out towards the enemy a large and active screen of cavalry, who resisted stoutly the penetration of the hostile patrols. But patrols whom they could not resist were those whose view-point was the air ; nor could the German Flying Corps check their work. On the 4th and 5th of September the German right began its swinging movement ; and

## Our Airmen above the German Right

below will be found an extract from *The Daily Telegraph* of September 8th:—

“The beginning of the alteration of the German plans was noticeable at Creil. Hidden by a thick screen of troops from the army in the field, but observed by the aerial squadrons, the enemy was seen to be on the move.”

Field-Marshal Sir John French, in his dispatch of September 17th, also makes clear the debt he owed his air-scouts. He writes:—

“About September 3rd the enemy appears to have changed his plans and to have determined to stop his advance south direct upon Paris; for on September 4th air reconnaissances showed that his main columns were moving in a south-easterly direction—generally east of a line drawn through Nanteuil and Lizy on the Ourcq.”

Here was news, and news of the utmost importance; and the Allies acted on it promptly. They changed from the defensive to a vigorous attack. The French Army had been reinforced; so had the British; and Von Kluck, to his discomfiture, had a taste of his own medicine. He had striven a week or so before, with all his strength, to crush the Allies' wing. Now he in his turn, and with a suddenness for which he was not prepared, found that his flank was gravely menaced, and by a foe dangerously strong and determined.

It was then, almost with the quickness of a

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conjuring trick, that the aspect of the campaign changed. At one moment the Germans were on the offensive ; the next, leaving guns and ammunition-wagons behind them, they were in retreat. The Allies, concentrated at the crucial moment and in the critical direction, gave a demonstration of what General Foch has called "the economy of force." They not only struck hard, and with a large body of troops, but they struck also just at the moment, and at the place, when their blow would be most damaging to the enemy. The right of the German Army reeled ; but it did not break. Then it moved heavily backward, and carried the rest of the line with it, the Allies grimly at its heels.

## VIII

### SCOUTS WHO COULD NOT BE MISLED

*"Our aeroplanes report that the enemy's retreat is very rapid."*—BRITISH HEADQUARTERS.

AGAIN, in this third stage of the campaign, the British air corps was able to do vital work. There was risk for the Allies, and they realized it, in pressing too closely on their retreating foe. This risk exists for any army which, with news as to an enemy's retirement that is no more than vague, forces home too impetuously its pursuing movement. If the enemy is retiring in good order, with his ranks firm, he may select in his retreat some stretch of land that suits him well, and then turn and deliver a vicious counter-attack.

Before they could drive home their pursuit with its fullest weight, the Allies wanted to know how rapid and general, behind the screen of its rearguards, the German retreat had grown. Such news, naturally, the enemy was not disposed to grant them. Von Kluck had thrown out a powerful rearguard, and this fought bitterly, delaying the Allies at every turn, and yielding ground

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doggedly yard by yard. To penetrate this screen, and see what was happening beyond, was a matter of extreme difficulty—when attempted, that is to say, on land. But the German rear-guard, stubbornly though it fought, offered no resistance that was material to an air-scout. And so again, as they had done on that critical day at Mons, the pilots soared up above the enemy's lines. Out they went, and soon returned. They had flown above the German rearguard, had penetrated deep into the enemy's lines ; and everywhere, with no doubt at all as to their precipitancy, the Germans were in retreat. Von Kluck's yielding was no master-stroke of strategy ; it did not mean that he was, merely to entice his foe, giving ground for a spell, only to strike again with a greater force. The Allies had won the initiative, and their blow had been shrewd and hard. And now they knew, thanks to the aviators, that the enemy's retirement was compulsory, and that the tide was ebbing even faster than it had flowed.

## IX

### THE BIRD'S-EYE VIEW OF WAR

*"It is a wonderful thing to see a big battle from above."*—A BRITISH PILOT.

AIRMEN in this campaign, flying out on their errands of observation, have seen sights that are strange. From their point of view above, they have watched battles ; have seen a line of troops—appearing at their altitude so tiny and remote—surge forward suddenly in an attack, only to halt and reel under a hail of lead. The man on the ground sees but his own limited sphere of action, just the small section of a battle that is waged around and before him. But to the aviator, 8,000 feet above, the field is stretched out as a panorama. He sees the long-drawn lines as they oppose each other, trenches scarring the fields and hillsides. He sees the artillery as it shelters behind slopes or in the clearings of woods. He sees a flash from the muzzles of the guns ; and then, perhaps three or four miles away, comes the puff and scatter of the bursting shell. Looking down from his vantage-point, he seems detached, remote. What suggests itself to his mind is that



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he is gazing on insects and not on men—on the disturbance of some giant ant-heap. He sees everything as it is spread below him: the devastation of the fire; the trickling forward and backward of the tiny lines of troops; an attack thrust home with dreadful loss across some open space; and the sudden sweeping charge of a cavalry squadron, which, after lurking half a day in the shadow of a wood, may swing out at a crucial moment and attack a column of infantry on its flank.

One of our Flying Corps pilots who, during the fighting at Mons, was scouting over roads to the rear of the British lines, has explained how he was impressed by the sight he saw below.

“As we went out,” he says, “the guns were getting to work. I saw two German batteries with our shells bursting over them like little bits of cotton-wool. . . . When we came back, houses were burning at Jemappes and Mons, and stacks were burning all over the place from shell-fire. I saw one of our trenches and a German attack coming off. They were coming up in a long, dense column, with the head all spread out in front; like a large, human tadpole.”

This represents graphically, from the aviator's point of view, the heavy thrust forward of the German infantry, and the development of its formation as it nears the hostile lines. Another British pilot has written:—

“One can easily see the flashes of the guns of both sides, extending miles right and left, and

## The Bird's-Eye View of War

one can see also the shells explode, and estimate the accuracy of the shooting."

A third flying officer, while explaining to those at home his life at the front, says :—

" At six o'clock you are just finishing breakfast. In less than an hour you are in the air, twenty odd miles away, with a battle going on under your very nose—hundreds of thousands of men in various positions, pegging away at each other from their various trenches. . . . It looks so funny from the air because you can see it all, and both sides, whereas down below they cannot see what they are firing at in a good many cases ; it is merely scientific slaughter. . . . It is awfully interesting to notice the old positions which have been abandoned owing to shell-fire. You can see great holes where the shells have burst all round them."

Yet another pilot, after making an evening reconnaissance during the battle of the Aisne, has given his impression in the paragraph below :—

" We flew at 5 p.m. over the line, and at that time the British guns—artillery, heavy and field—all opened fire together. We flew at 5,000 feet and saw a sight which I hope it will never be my lot to see again. The woods and hills were literally cut to ribbons. . . . It was marvellous watching hundreds of shells bursting below one to right and left, and then to see the German guns replying."

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But the aviator on active service, though he may feel quite keenly that there is drama in all he sees, is not a painter of word pictures—not, at any rate, consciously ; nor has he the time for such a literary exercise. He sees shells bursting—well and good ; that is a part of his work of observation. He notes the position of the trenches ; that again is his duty. But he has not the leisure nor the inclination to meditate upon the extraordinary position he holds, suspended, as it were, above these fields of conflict.

## X

### ARMIES THAT ARE INVISIBLE

*"In the hazy valleys, bathed in sunlight, not a man, not a horse, not a gun, not even a trench was to be seen. There were only flashes, smoke, and noise."*

OUR BRITISH "EYE-WITNESS."

ONE fact, and it is curiously interesting, has impressed itself on the men who have flown in this war, also upon those who have watched battle fronts from hills or the tops of towers; and it is the fact that, though hundreds of thousands of men may be battering at each other in the fiercest of encounters, there is amazingly little to be seen, even from the air—extraordinarily little, that is to say, which tells of all this human conflict. It was Count Schlieffen who foretold—and his prophecy has been fulfilled—that the war of the future, though waged by huge masses of men and vast numbers of guns, would be fought in landscapes apparently as empty as a desert. Modern war, indeed, is, as one of our aviators has said, "merely scientific slaughter." Each man digs himself into the earth and shows no sign of movement. The artillery hides itself with cunning. And for hours, though the air between

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the two armies may be swept by a hail of death, there is nothing that stirs or shows so much as an arm or leg, or indicates in any way that there are human beings who control this dreadful tumult. Often, save for the aeroplanes which circle high above the scene, there is nothing save the bursting of shells to tell that a battle is taking place.

An inhuman form of war this—precise, mechanical, deadly, unemotional. The individual unit, the ordinary man with a rifle, fights doggedly and sees nothing. One of our wounded soldiers, home from the front, has told us that, after many days in the trenches, firing his rifle until it grew hot in his hands, he had not seen one German—nothing save a bleak and empty hill, which spat death at him in a ceaseless stream of lead.

## XI

### WEATHER AND SCOUTING, WITH A REFERENCE TO WIRELESS

*"We find much to do every day."*

A GERMAN PILOT.

COUNTLESS flights have been made in this war, all attended by risk, few by failure. The weather has played its part—though a modern aeroplane makes nothing of high winds; while the type of country flown over has had its effect upon the airman's work. In land thickly wooded, remembering that smokeless powder gives no indication of a firing point, the observers in aeroplanes have had an extremely difficult task. In the first few weeks of war, from an atmospheric point of view, the Flying Corps had everything in their favour; and subsequently, even when it turned cold, the air remained clear. The cold, however, was occasionally intense, particularly at high altitudes—50 degrees of frost being encountered, more than once, in early-morning flights at 5,000 and 6,000 feet. On several occasions, when alighting after a flight of several

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hours, and despite the fact that they had been very warmly clad, the airmen and their observers were so numbed that they had to be lifted from their seats. Then, as autumn crept on, there came troublesome mists—usually in the morning and evening ; and these were a hindrance to the observers.

In November again, notably during the fighting between Dixmude and Arras, there were gales which made flying perilous and at times—but only for short periods—impossible. An idea of the adverse conditions against which our aviators had to contend is conveyed by this extract from one of the official “ Eye-witness’s ” reports. He refers to Sunday, November 15th :—

“ The weather on this day was about the worst we have yet experienced. It was bitterly cold, and rain fell in torrents. Nevertheless, in spite of all difficulties, our aviators carried out a successful reconnaissance. For some time they hovered over the German lines, observing the emplacements of batteries, and searching the roads for hostile columns, in the midst of a storm of driving snow and sleet which was encountered at high altitudes.”

Sometimes flying is impossible ; and it is then, deprived of the use of their flying craft, that armies are made to realize what air reconnaissance means, and how awkwardly placed they are when it cannot be performed. Mr. Hodson, of the *Central News*, writing from France during

## Effect of Weather on Scouting

a week when a gale had hindered flying, observed :—

“ The Commanders on both sides are having anxious times, endeavouring to discover fresh concentrations of troops by the enemy. They find themselves suddenly ‘ blind,’ as it were, and with so much depending on the fight, the sensation is not pleasant.”

Against the wind, taking the campaign week by week, the air corps have waged a successful struggle. Apart from the actual strength of the wind, whatever this may be, there is a greater risk for the airman from gun-fire, should he be flying over the enemy when the wind is high. The wind, if it is contrary, will materially reduce his speed ; hence he becomes at once an easier mark. After a flight, one day, in which he had struggled against a head-wind, a British pilot came down with sixty bullet-holes in his machine ! Fortunately for him, his craft was one of the type that had been armoured lightly beneath the hull, and this saved him from being hit.

The German Taubes and arrow-shaped biplanes, thanks to their inherent stability, have been out in gales ; and the British air service, through the possession of craft that have automatic stability, has also been working in weather which, even a year ago, would have been considered impossible. One machine, built by the Royal Aircraft Factory to designs



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prepared by the National Physical Laboratory, attains its stability, as do the German craft, by the shaping and placing of its wings and the use of vertical fins ; and in the gustiest of winds, although it will roll and quiver in rather a disquieting way, the machine refuses to lose its equilibrium, and rights itself after the thrust of every gust. To the pilot this is a quality beyond all price. Not only does it enable him to fly in winds that would otherwise be out of the question, but it relieves him of an immense amount of physical strain. In the early days of aviation, when men were beginning to wage their fight against the wind, it was not so much the risk of being overturned, as the muscular fatigue of their work at the controls, that compelled them after a short while to descend. But to-day, such is the inherent stability of a craft, that a man can ascend when the need is urgent, or there is a record to be broken, and remain aloft without alighting for many hours. The long-distance record, held by our enemies the Germans, now stands at twenty-four hours ; and this was a continuous flight, made by a pilot who was alone in his machine. When he came down he complained little of fatigue ; his chief trouble had been that the palms of his hands grew sore, through his constant grip upon the steering-wheel.

In this war, thanks to the stability of aircraft, and the skill and experience of their pilots, flights of three hours and longer have been the rule ;

## Effect of Weather on Scouting

and in a single journey, out and back above the enemy's lines, pilots have traversed constantly a distance of more than a hundred miles. An account of such a flight, with incidents and excitements that are typical, has been written by a German pilot, and has appeared in the German aviation paper *Flugsport*. This aviator, who flew a Gotha type of Taube monoplane, describes a voyage into France :—

“ . . . I was ordered next morning at sunrise to fly in over the enemy's land. My task was this : to go from our garrison over a French fort ; from there to cross the Meuse and examine the lines of defence on the western bank ; and then to fly back again—in all a distance of 170 miles. I made my preparations until midnight, studying closely the map, upon which I drew up my route.

“ Next morning, at the first cockcrow, my ‘ Taube ’ was drawn out of its shed. I started from the manœuvre ground, steering west, and in half an hour had risen to 4,000 feet, and had almost reached the French fort. Suddenly my observer, Lieutenant —, called my attention to some small clouds of smoke in front of us. At once I understood. We were being shot at by the French artillery ! I rose to 6,000 feet, but still the shots did not cease. However, as they did us no harm, we looked about us, and then saw all at once that we were being chased by three hostile aeroplanes. But these, to our great astonishment, soon disappeared. Afterwards we learned that two of them had been brought down by our artillery, and that one of the aviators had had his hands taken off by a shell.

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"We flew on ; and, as had been agreed between us, gave three cheers when we crossed the frontier. Then soon we were passing over battle-fields which had been made famous by the war of 1870. Now we caught sight of a large body of troops marching north-east ; and from this moment we were shot at constantly.

"Once we saw a company of soldiers halt in the road, raise their guns to their shoulders, and prepare to fire up at us. Silently I sat in my machine, waiting to see what would happen. Then, quite suddenly, the whole monoplane trembled. And that was all. It was not until later I found out that, of this one volley, four bullets had perforated my planes.

"Still adhering to my route, I flew on, reaching V—— and then turning east. What I observed after this I am not allowed to say ; but it was after a flight of three and a half hours that we returned and made our landing, and then drove in a motor-car to Headquarters, and delivered our report by word of mouth. The Commander-in-Chief, when we had finished, said our news was undoubtedly of the greatest importance. He shook hands with us and thanked us."

This pilot, it will be noted, refers to a drive to Headquarters in a car, and the delivering of his report in person. This method is employed frequently ; but there is one that spells greater speed, and is for this reason superior. It is the communicating of reports by wireless, direct to the earth from a machine in flight.

Wireless telegraphy, in its application to aircraft, is still much in its infancy. Airships, which are able to raise heavier weights than aeroplanes,

## Effect of Weather on Scouting

have been fitted with successful plants, and have sent messages over distances of several hundred miles. During tests which were made in 1913, with one of the Zeppelins, a series of messages was exchanged—over a period of days and under various weather conditions—between the airship, which was cruising along the Upper Rhine, and various air-stations which were at a distance of from 150 to 200 miles. With the present-type aeroplane, the carrying capacity of which is somewhat limited, the mechanism of the wireless has to be reduced, not only to its smallest weight but also to the least possible size—there being little room, in the hulls of existing craft, for the stowage of apparatus. Such limitations have spelt difficulties; and there have been technical problems as well, such as the impossibility of an earth connection; while the noise of the motor, when a craft is in flight, interferes with the receiving of a message.

The absence of an earth connection has been overcome by running a system of insulated wires round the machine, or else by connecting electrically all the metal parts of the craft and making them form a conductor. The "aerial"—the wire, that is to say, from which messages are flashed out—is arranged so that it will trail down below the aeroplane as it flies, being weighted at the end to prevent its curling back in the wind, and being wound over a small windlass in the machine, so that the operator can draw it up before a landing is made. The power for the

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wireless plant is derived from the engine of the aeroplane, a belt gearing being used—or sometimes a small, separate motor is carried; and the whole weight of the apparatus, including mechanism for sending and receiving messages, can be brought well within 200 lbs. Such a plant, of course, cannot possess the range of that used in an airship; but communication may be established over distances up to fifty miles; and occasionally this is exceeded. The occupant of the aeroplane sends his signals in the Morse code, tapping them out as is usual with a transmitting key; while for receiving, in order to overcome the difficulty of the noise of the engine, he has a magnifying apparatus which increases very greatly the strength of the signals that reach to him, and for which he listens, as is the rule in wireless, with a pair of telephone ear-pieces.

The application of wireless to aeroplanes has, in the British Flying Corps, been studied very carefully; a number of the machines sent to the front have been equipped with an excellently devised plant. Of their work we have heard little; it has been subsidiary to the general scheme. But they have been employed, and with success, when there has been need for rapid communication between air and land; and in the official history of the war, when there is time and space for detail, "wireless" will be shown to have played its good and useful part.

## XII

### THE FINAL PROBLEM: SPEED AND GUNFIRE

*"There is no question at all about one thing: the air must be moved through fast."*

THE LATE CECIL S. GRACE.

EMERGING from the problem of air-scouting, as studied during the war, there is a point that has a culminating interest. We have shown how, through the practice they gained, the gunners who fired at aircraft improved in their aim; and we have mentioned also, though briefly, that if the air is not clear, and there are mists near the ground, the pilot of an aeroplane needs to fly low. These two facts, as winter came, and the nations were still at war, began to exercise a powerful influence on the working of the air-service.

Flights, of course, had still to be made: weather must be ignored in war. Yet, owing to the state of the air, which grew steadily less favourable, machines were obliged to creep closer to earth. And all this time, it must be remembered, gunners were improving in their aim. So the air patrols found themselves in an

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unenviable plight. Just by the time they were forced to fly low, if they were to gain news of value, the land-guns had increased materially in the accuracy of their fire. The problem is, of course, familiar—simply that of move and counter-move ; but it is men's lives that are at stake.

One of the officers of our Flying Corps, who was making special observations on a misty day, paid the penalty that has sometimes been exacted for flying low ; he came within range of a murderous fire, and his machine was crippled. But he escaped with his life, and was able to describe his adventure to Mr. Beaumont of *The Daily Telegraph*. The pilot said :—

“ A bullet hit one of the stays, and smashed it ; a dozen others tore holes in the canvas ; the motor suddenly stopped, and I had to make a gliding descent towards our lines. I never expected to do it, but it seems I succeeded all the same.

“ What really happened others will have to tell. I was unconscious at the time. All I can say is that we were within about 200 feet of the ground when our machine turned upside down. I am told it was pretty badly smashed, and that I had my foot stuck under the motor. My comrade was not much injured. I came to in the ambulance tent, and felt a severe pain from the right ankle up to the knee. But no bone had been broken.”

Mr. Robert Loraine, a well-known actor, who watched Blériot start for his flight across Channel

## The Final Problem : Speed and Gunfire

in 1909, and learned subsequently to fly a Farman biplane, was also hit by shrapnel during a flight in which he was compelled to pass low over the German lines. This occurred in Belgium, in November, while he was on a special scouting flight. Mr. Loraine had, it should be explained, volunteered for duty as a pilot with our Flying Corps.

“ I had been working daily over the enemy's lines,” he told a friend, “ but they bagged me at last. An anti-aircraft battery, with which I had had previous dealings, interrupted me by sending a shrapnel ball into my back between the liver and the spine. It came out near my neck in front, after traversing en route the right lung from bottom to top.

Mr. Loraine was not at first expected to live ; but a sound constitution, standing him in good stead, enabled him at length to recover from the wound, dangerous though it was.

Unable to fly high when the air grew dense, pilots had but one safeguard left them : this was their speed. And so it grew to be a case of flying deliberately through the enemy's fire, and not above it. A premium was placed on speed. In our British service in France there came into use a machine which, although built for war and not for sport, beat every record for speed that had been established in peace by purely racing craft. This machine, the tiny biplane known as the “ bullet,” was given a motor of 160 h.p., and



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could pass through the air at a speed of more than 130 miles an hour. Even when flying low, granted it can attain such a pace as this, a craft has been found to offer an extremely difficult mark. It sweeps up with a hum from its motor, and flashes into view—perhaps only just above the tree-tops—at its amazing speed ; then, almost as soon as it is sighted, and in many cases before guns can be levelled, it has faded to a speck and disappeared.

This is the airman's reply to gun-fire, and to meet the need for flying low ; and no limit of speed has yet been reached. With perfected craft, such as the future should bring, men should be able to pass through the air at two hundred miles an hour.

## XIII

### A NOTE CONCERNING SEA-PLANES

*"The biggest seaplanes of to-day are mere toys in size, compared with the sea-going machines of the future."*—MR. C. G. GREY, EDITOR OF "THE AEROPLANE."

THE land aeroplane has, for its work of scouting, attained a reasonable efficiency; but the sea-plane, which is the marine air-scout and coast patrol, is still a very crude machine. In this war therefore, as was inevitable, the performances of the sea-plane have, with the exception of the affair at Cuxhaven which we describe elsewhere, proved a little disappointing; though it has found many uses that have not been made public, and will provide a better showing when official records are prepared. As a coastal patrol, passing from harbour to harbour, sea-planes have done useful work; and there are gun-carrying craft at our naval air-stations, intended for defence against air-raiders, which are by no means to be despised, and will show what they can do if the chance should come. Sea-planes are valuable also, and have

## Aircraft in the Great War

been used frequently, for such journeys oversea as they can perform in a single flight, and without having to rest on exposed and perhaps turbulent water. Also, though to a limited extent—owing to technical difficulties which have not yet been overcome—they may be used with a fleet at sea, rising from the deck of a ship that has been made ready for the purpose, and alighting after their flight in the water beside the vessel, being then lifted and brought aboard. In patrol work, particularly near harbours or positions of strategic importance, the sea-plane has done admirable service—notably in scouting for submarines. The pilot, from his bird's-eye view, can detect these elusive craft when they are moving awash. Even when they are submerged, their periscopes, under conditions favourable for observation, leave a small wake behind them, as they pass through the water, which can be seen by the observer from aloft. And the sea-plane has found a task also, on occasion, in locating mines.

But in its present stage of development, and for rough-and-ready service, the sea-plane is too small and weak a craft. Should a pilot be obliged to alight on open water, when waves are running high, the machine is so inherently frail that it is battered to pieces. And this, in a craft designed to work over water, and with frequent need for resting upon it, is a very real drawback. It has restricted the use of our naval planes over the North Sea. Notwithstanding

## A Note Concerning Sea-planes

these limitations, however, excellent patrol work has on occasion been done ; and we have the knowledge also that, though all sea-planes are in their infancy, our British craft are, for every practical purpose, distinctly in advance of those of other countries.

What is needed, and what experiment should provide, are larger, stronger, and more powerful machines—craft which will, if necessary, ride without damage even on choppy water in the North Sea. With the sea-plane also, when on long flights away from land, it is essential that engine failure should, so far as is possible, be guarded against. This entails the fitting to machines of a duplicate power-plant—three or four motors, say, working separately or in unison as the need may arise. But so far, though experimental craft have been built, the duplicate-engined sea-plane is not a practical machine. Technical difficulties await solution ; but with time and money they should be solved.

There is a field of utility also for a small, high-speed machine, a type of rapid, high-seas scout, which can be carried in the hold of a parent ship and launched from her deck, returning to the vessel after its flight and alighting on the deck. Already there are machines which, in suitable weather, can be sent into the air from a ship ; and it has been shown also that it is possible, again under favourable conditions, for an existing-type craft to make a descent on a ship's deck. But in anything like a wind, or

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in a high sea, such work is rendered highly dangerous and almost impossible ; and this merely because the right kind of gear, and the most suitable type of craft, have not yet been evolved.

The sea-plane has an important future, particularly in its co-operation with the British Navy ; and this war will have taught its makers useful lessons. But craft used to-day are, if contrasted with the machines we should have even a few years hence, the merest cockle-shells. The sea-plane of the future will be large and staunchly built, an all-weather machine. She will have duplicate engines developing thousands instead of hundreds of horse-power, and an ability to move fast on the surface of the water and fly at extremely high speeds when in the air. She will take her place, in fact, when she is perfected, as a type of super-destroyer by air, invaluable for high-speed scouting or a quick offensive.

**PART FIVE**

**BOMB-DROPPING FROM THE AIR**



# I

## ETHICS OF AIR ATTACK

*"The test of the legitimacy of any engine of war is, in the end, its effectiveness."*—DR. J. M. SPAIGHT.

WHAT has been learned about bomb-dropping from aircraft has been learned almost entirely since the beginning of the war ; and the lessons taught have surprised those who, not many months ago, were found ready to declare that, for destructive work of any significance, the present-type aeroplane was a factor of no account. Bombs, as a matter of fact, have been dropped from the air—an astonishing number, indeed. In the space of a few days, during the fighting in Flanders, our British pilots let fall upon the enemy more than a hundred missiles. And though the results, save in certain cases, have been moral rather than material, still there have been results ; and in one or two such affairs, when conditions have been favourable, the bomb-droppers have done work which was important, and could not have been achieved by any other means.

But the sceptics have had ground for their



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views. They grant small importance to the modern-type aircraft as an instrument of destruction; they are apt to smile at the feats which have been chronicled in this war. Their real point of view—and to a certain extent a reasonable one—is that hardly anything can be done, at any rate in this campaign, that will foreshadow the powers of a perfected craft: that huge machine of the future which, fully armed, and able to hover over a given spot and take an accurate and deadly aim, will shower death in many dreadful forms—bombs containing terrible explosives; others releasing suffocating fumes; others, again, which will spread fire over everything they touch. This is a dream of the future—a nightmare rather; and there are those who say that, before this evil day can come, aircraft will have made war so terrible that humanity will revolt.

As it is, and from many quarters, there have come protests against the use of aircraft for purposes of destruction. That they would be so used, and in this war, was not for a moment doubted. What has been surprising is the amount of damage they have done. Not that this damage has been considerable, for it has not; but it has been far greater than many would have thought possible. With no experience worth the name, and with no missiles or releasing-gear that were anything but experimental, the aviators in this campaign have been

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able—almost entirely through their own courage and skill—to pursue a guerilla form of warfare which, merely from its harassing and disconcerting aspects, has had a marked effect upon the enemy attacked.

But is not aerial bomb-dropping to be condemned as barbarous? Should an enemy be allowed to rain explosives from the air into a city, killing and wounding its citizens? If there can be any limit in the terrors of war, should not an attack from the air represent that limit? These are questions that have been raised; and there has been a storm of indignation when, from time to time, the Germans have dropped bombs upon Antwerp, Paris, or Dunkirk. The point has been advanced, and strongly represented, that such destructive raids are merely wanton, that they serve no military purpose.

To these objections there are rejoinders, and they are not made necessarily by men who are inhuman. War is war. This is a platitude, but it needs to be understood. When you begin to fight, when you decide that the sword, and the sword alone, is your last court of appeal, then you must fight as fiercely and as relentlessly as you can—using every weapon that can aid you, or any new terror that may shake the *morale* of your enemy, and incline him to lose courage and yield. War is like nothing else; it breaks down the conceptions of ordinary life. To understand it, to appreciate the point of view of those who wage it, we must seek new values.

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“Quite so,” readers may agree. “But are there not rules of war, which civilized nations have agreed to adopt?”

That is so; and as regards aerial bomb-dropping, when this is practised, no laws are broken because no laws have been made.

“But,” objects the reader again, “what about the dropping of bombs on undefended cities?”

Here, as is often the case in regard to warfare, there is a misapprehension. When bombs were dropped on Antwerp, for example, and when others were let fall above Paris, there was condemnation of the act, people being led to suppose that it was a violation of the rules of war. But it was not. The enemy was within his rights in dropping bombs on these cities. They were not defenceless cities, but were in fact strongly defended—at any rate, according to the rules of war. In this question of “defended” or “undefended” cities there lies the crux of the matter. Article 25 of the regulations annexed to the Hague Convention of 1907 places on record the words:—

“It is forbidden to attack or to bombard, by any means whatever, towns, villages, habitations, or buildings which are not defended.”

This rule, which is so specific, has been taken to mean that no bombs should be dropped by aircraft upon towns or cities, and that, in fact, all bomb-dropping from the air is illegal. But this article gives no explanation of when a town,

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from the aviator's point of view, should be considered defended or undefended. There do not exist, as a matter of fact, any rules to govern aerial bombardment. None have been drawn up, because this problem was regarded as so new and so strange that, until there had been a war, few authorities cared to grapple with it.

Why, it may be asked, could not the nations have agreed to prohibit bomb-dropping? The question was brought up at the Hague Convention, and no general agreement could be obtained. The proposal was that aerial bomb-dropping should be excluded from war, and certain nations were willing to agree. These were Great Britain, the United States, Austria, Belgium, Greece, Norway, Holland, Portugal, Switzerland, and Turkey. What was actually agreed was this : that in any war, as between these countries mentioned, they would refrain from using aircraft for the purposes of dropping bombs. But they made it clear also that, should they be fighting against any of the nations which had not signed this agreement, or in alliance with any of them, then they should be free to drop bombs if they cared to do so. Among countries which were unwilling to exclude aerial destruction from their weapons of war were Germany and France. In this campaign we have Germany as our enemy and France as our ally ; and, as Germany and France drop bombs, we do so also.

What the question amounts to, in plain language, is this : both Germany and France recog-

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nized that they had, in the aeroplane, a weapon that might be valuable in raids across the frontier. Therefore they were not willing to deprive themselves of its use. Again the platitude—war is war; and Dr. J. M. Spaight, who has studied closely this problem, has told us in his book "Aircraft in War"—while discussing the legitimacy of any new weapon such as the aeroplane :—

" If the results which it achieves are sufficiently great to be regarded as justifying the incidental suffering of its victims, if its ' bag ' is large enough, then the conscience of the world has no difficulty in approving its use."

This is plain-speaking ; at first sight it may appear brutal ; but the standpoint, when the business is that of war, is the right one. Nations, when they go to war, fight to win, and it is permissible to use all methods save those which are barbarous. If one country, by dropping bombs from airships over another, can produce a panic among the public, it is justified in using this weapon. The policy of Germany in war is, among other things, to strike terror into the hearts of all civil populations she encounters. There arises, however, a point which, having regard to the experiences we have had of bomb-dropping, suggests a paradox. Dr. Spaight says the world will approve an engine of war " if the results it achieves are sufficiently great," or if they can " be regarded as justifying the incidental

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suffering of its victims." It is here we may find the reason why, in this war, aerial bomb-dropping has been so vilified. Its "bag" has not been large enough. This without doubt, apart from the strangeness of the new form of attack, has been the point which has, more than any other, raised a storm of protest. Bombs have fallen, for example, over Paris, and they have been so ineffective that only an old man and a child have been injured. Here is no excuse, no redeeming feature. Had this bomb, falling, say, a mile away, killed ten soldiers and driven a hole in the roof of a railway-station, the question would have been different. Aerial bomb-dropping over cities has, as a matter of fact, been a conspicuous failure. It has held up the attacker to the odium of the world, and has done him no good. Had a hundred aeroplanes been ready to make an attack, and had they been armed scientifically for their work, then the general attitude might have been different. The greater the damage done the less strenuous would have been the protests. Imagine a single piece of artillery dropping shells here and there into a city. How wanton and disgraceful this would appear, simply because no end was served. But with fifty guns, all doing their work, the attack becomes at once a bombardment, which has to be endured because it is an act of war that is familiar and has a definite purpose.

## II

### AIR RAIDS COMPARED WITH SEA RAIDS

*"The sufferings of residents are but an unfortunate incident of the execution of an approved act of hostilities, and complaint is useless."*—DR. J. M. SPAIGHT ON NAVAL BOMBARDMENT.

AN attack from the air, in the problems to which it gives rise, resembles a bombardment from the sea; and, in the absence of specific rules to govern aerial attack, it is now agreed—though not generally—that the conditions which affect a sea bombardment should apply also to one from the air. In this war indeed, though no official statement has been made, or has been expected, it has been upon these laws of naval bombardment that aviators have relied. The code as to naval bombardments lays it down that any works or buildings may be subjected to fire that can be utilized by the enemy for the needs of his army or fleet—any articles, objects, or buildings that come, in fact, under the comprehensive French heading of *matériel de guerre*. The importance of this specification, the wide field it covers, is apparent immediately. It

## Air Raids Compared with Sea Raids

includes, for instance, harbours, docks, and railway-stations, in addition to warlike stores and military establishments. Any town which contains such *matériel de guerre* may be fired upon ; and, seeing that aircraft are considered to be using this code, they must so classify a city that is to be attacked. Antwerp, which was defended by an army and surrounded by forts, and contained in addition a large quantity of warlike stores, was obviously a city that might be attacked. So was Paris ; so also is London. If when a warship, or an aircraft, attacks a defended city, and its missiles strike a civilian instead of a combatant, or the roof of a private dwelling instead of a railway-station, this is merely the ill-fortune of the civilian. There is a point in this regard, however, that should be considered, because it is pertinent. Before a city is bombarded, according to the rules of war, twenty-four hours' notice should be given, so that the civilian population may be removed to a place of safety. But in the air raids made during the war, and notably in the case of those at Antwerp and Paris, no such notice was afforded. It was hardly likely, indeed, that it would have been. The main purpose of an air raid, its hope of success, is that it should come as a surprise ; therefore to give notice of it, twenty-four hours ahead, is simply to allow your enemy to gather together his defending aircraft, place in position his special guns, and frustrate your attack when it is made. The



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twenty-four-hour rule, so far as aerial warfare is concerned, appears unworkable.

"But," objects the reader, "what harm, or rather what effective damage, can be achieved by one or two aeroplanes, which drop bombs haphazard and then fly away? They smash the roof of a building, tear a hole in the street, kill two or three men outside a café. But what is the good of it—what does it do?"

This aspect of the matter has been considered, naturally, by those who have used aeroplanes for purposes of destruction. That any appreciable damage would be done was not thought likely; but what the Germans have borne in mind, in the raids on cities they have perpetrated, is the disturbing effect these might have upon the populace, apart from buildings that might be struck or people killed and injured. The result desired was, in a word, moral rather than material. The Germans hoped to frighten the people of Antwerp and Paris, to cause them to run about in crowds, to send them in clamouring masses to the Government Offices—to sow the seeds of a panic, embarrass the authorities, and weaken the determination with which the war was being waged.

It has been one of the tricks of war always—a side issue, of course, but none the less an important one—to frighten and spread uneasiness among non-combatants, to weaken a nation, that is to say, in a most vulnerable direction, and cause the public which

## Air Raids Compared with Sea Raids

has been supporting the war to clamour that it should cease. Napoleon was industrious, always, in seeing that stories should be circulated as to his superhuman power. When camped near Boulogne, with the armies that were threatening England, he never missed an opportunity of trying to frighten the British. As his intelligence officers returned from trips across Channel, he would ask them specifically, and with much eagerness, what the effect was upon the public in England of his contemplated invasion. "What do the people say? What do they think?" Such were his questions. He knew the value, more than any other man, of shaking the confidence of a country before attacking it, of spreading irresolution and secret fears. And although England stood firm then, and stands firm now, and refused to be the victim of any scare, still Napoleon must have been grimly pleased when he heard, as he must, that the mothers of England, if they could not get a crying child to sleep, would hush it to silence with the threat that "Boney" was near.

The Germans, waging war with all its rigours, and hampered by no sentiment or scruple, saw in the aircraft—as it exists to-day—an instrument of terror rather than of actual destruction; and as such it has been used. That they would be exposed to odium for so using it they must have recognized, and were prepared no doubt to accept the consequences. They had staked

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everything, were fighting for life or death, were prepared to use every instrument, no matter how seemingly treacherous or unsportsmanlike, that would advance their cause or harass their enemy—drifting mines, air bombs, false reports, a multitude of spies ; anything and everything that came to hand.

Air attacks on cities have appeared despicable largely because they are so new, and have affected us with a sudden and painful shock. What could be more sinister or treacherous than the attack of a submarine? Yet, because we have grown accustomed to the thought of this submerged terror of the seas, we no longer feel so violent a distaste when we read of its work. When one compares the submarine with an aircraft, from the point of view of their work in war, the former appears the more dreadful. Creeping up invisible, giving its victim hardly a chance of striking an effective blow, it launches a torpedo and then steals away, while a great ship reels and sinks, and hundreds of men—none of whom perhaps have seen their foe—may struggle in the water and drown. With the aircraft, when it attacks, there are defensive guns that can be employed against it ; even at night-time it may be detected by searchlights ; and, in addition to resistance from the earth, airmen may rise and fight it in its own element. The aeroplane rains death from the air, it is true ; but so does the

## Air Raids Compared with Sea Raids

artillery which, posted perhaps four or five miles from a city, and with its gunners unable to see what they are aiming at, simply throws shells into the air with the hope that they will descend in some given area and do a maximum of damage.

Concerning attacks made by aeroplanes on cities, and the damage which has resulted, there has been misapprehension. When civilians, passing along a street, have been killed or injured by an airman's bomb, it has been made to appear, in hastily-written reports, as though the aviator above, leaning from the side of his hull and releasing his bomb, had aimed specifically at these pedestrians. But, from the height at which he flies, nothing is visible to the pilot save the main buildings and the general outline of a city. Before starting on his raid, he has determined to drop his bombs over some given spot ; this, preferably, would be a railway-station, or a wireless plant such as is found on the Eiffel Tower in Paris, and on our Admiralty in London. Naturally the airman seeks to frighten the people of the city ; that is a part of the plan. But he does not want his bomb merely to drop in a street, dig a hole in the ground, and wound some foot-passenger who may be passing. He prefers, if he can, to hit the railway-station, from which troop-trains leave for the front, and bring down a portion of its roof and damage the rolling stock within ; or he would be de-

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lighted if he could paralyse for a time the enemy's wireless communication. It is a poor result, from his point of view, if the falling bomb—released perhaps a moment or so too soon—sweeps over its intended mark and bursts in some side street the airman has never seen.

### III

## PROBLEMS OF AIMING FROM THE AIR

*"Go to the roof of the Woolworth Building [New York], and endeavour to drop a dozen billiard-balls into a pail placed on the side-walk. Then imagine yourself at a height two or three times that of the building, . . . and with the building in rapid motion through space."*—"ARMY AND NAVY GAZETTE."

BOMB-DROPPING from aircraft is a new art in war ; and, as it is extremely difficult to drop a bomb with accuracy from a machine in flight, the results obtained in this campaign have, from the point of view of actual marksmanship, proved unsatisfactory. Take the case of a German airman who, after reaching Paris on a raid, locates the Gare du Nord from an altitude, say, of 7,000 feet, and endeavours to place a bomb on its roof. He needs to fly precisely on a line towards this mark, deviating neither to right or left ; and to do this in an aeroplane, and at a great height, is in itself no easy matter. Then, before he comes above the object of his aim, and at an exact moment which must be determined by his height above the ground, and by the speed of his craft, he releases his bomb. The missile,

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as it falls, has imparted to it the forward velocity of the plane ; it not only descends, that is to say, but sweeps forward as it does so, and at a speed given it by the aeroplane. If the pilot waited to drop his bomb until he was directly over his target—which would be simpler, of course, from his point of view—it would sweep far beyond the mark. There is one moment, therefore, and one only, at which the bomb must be released so as to carry it to its goal. If a machine is travelling at a speed of sixty miles an hour, at a height of 4,000 feet, a bomb dropped from it will travel 1,400 feet in a forward direction before it touches ground. This neglects the resistance of the air, and assumes that the bomb as it falls is acted on only by the force of gravity and the initial impulse imparted to it.

Besides the sweeping forward of the bomb, a pilot needs to consider very carefully, just before he discharges a missile, whether his machine is flying exactly on the correct line of approach. His aim may be accurate so far as the forward momentum of the bomb is concerned ; but if his machine, as it flies, is too much either to left or right, then although the bomb may fall where it should so far as fore and aft inclination is concerned, it will have swung off either to one side or the other, and so missed its mark. Nor do these questions end an airman's pre-occupation. He has also the wind to consider. As the bomb descends, should there be a strong

## Problems of Aiming from the Air

side wind, it will be borne off its course and carried perhaps some distance either one way or the other. So the airman, apart from his other calculations, must make an allowance for wind pressure; and even if he does so accurately, so far as the strength of the wind is concerned at the moment the bomb leaves his machine, he may still have his aim spoiled, and for this reason: as the missile descends it may pass perhaps into a current of wind, several thousand feet below the aircraft, in which the pressure is higher or lower than it was at the altitude from which the bomb was released. Such a sudden gust, driving the bomb before it, may upset the airman's calculations, and send the missile swerving from its path.

To aid the pilot, or his passenger, in the difficult task of dropping bombs, several pieces of apparatus have been invented, in the form of timing gears and releasing tubes. These are experimental; their worth is not yet proved; and pilots in this war, rather than depend on mechanism which is untried, have been content as a rule to trust their own eyes and skill. Some of the timing instruments are ingenious. One consists of a series of prisms, through which the bomb-dropper, seated within the hull of the machine, is given a clear view of the ground below. He obtains the altitude of the machine by a glance at the aneroid; then, placing his eye to the sighting-tube, he watches the passage across his field of view of some landmark on



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the earth beneath ; and the number of seconds this object takes to pass across his lens, when compared with a mathematical table which is fixed before him, tells him the speed at which his machine is passing through the air. He is able also to estimate whether his craft is making any side drift. His height and speed known thus with precision, he determines the moment at which he should drop his bomb ; and this can be done mechanically, merely by the pressure of a button. Releasing gears may be obtained which are fitted below the hull of a machine, and resemble the cartridge-chambers of a revolver. In each chamber there is a bomb ; and on the pressure of the button within the hull, the chamber below turns till it comes to the discharging point, and one of the missiles is released.

Occasionally it has happened, when a releasing gear has failed to work, that the aviators have been placed in an awkward position. In one case a bomb, as it fell, caught in a string and remained suspended just below the machine. Neither the pilot nor the observer could get at it, and they did not dare to attempt a landing with the bomb where it was. It would, had they done so, have exploded and blown them to pieces. Eventually the observer, rendered desperate, managed to kick a hole through the floor-boards of the machine, and hook the bomb free.

What airmen lacked, at the beginning of the

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war, was practice in bomb-dropping from high altitudes. If a pilot can steal down, say, to 500 feet, and his target is fairly large, he has an excellent chance of hitting it. But in war, in nine cases out of ten, he does not dare to come as near ground as this. The position he is attacking, should it have strategic value, is guarded by high-angle guns ; and if the airman risks flying low, and comes within the range of these guns, the chances are that he will be destroyed before he can drop his bombs.

From the altitude at which they have been forced to fly, and in view of their small experience, bomb-droppers in this war have rarely hit their mark. Aiming at a railway-station, they have struck perhaps some building a considerable distance away ; or when directed, say, against a military store, their bomb has fallen in a street or even on a hospital. This fact, naturally, has strengthened the protest against air attack. A German aviator, darting over Paris on a destructive raid, has released his bombs above the city more or less haphazard. He may have tried to hit the Gare du Nord or the Eiffel Tower, but he has had small hope of doing so.

Aviators are accused of barbarities of which they have no intention. A typical statement, and one quite wrong, is that, say, of an eye-witness who, walking with an ambulance-wagon near a railway-station, declares that a hostile airman, passing overhead at the moment, has dropped a bomb "deliberately" at the

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ambulance. What has occurred, really, is that a bomb has fallen near the ambulance, but that the airman above has not had the faintest wish to place it there. His aim was at the railway-station. From his height he could not even see the ambulance. Of course, had he hit it by accident, the result would have been distressing ; but the stigma should not be his that he aimed "deliberately" at this mark. Could the man who is aloft make such accurate practice as this—were he able to drop a bomb near such a small target as an ambulance-wagon provides—his bombs would not be falling wide of their mark at all, but would be dropping where he desired them to drop, and that is on the station roof.

Two facts in this war have held bomb-dropping to execration : one is the haphazard way in which missiles have fallen ; the other the apparent futility of such raids. Attacks on cities from the air, as practised in this campaign, have been merely an irritant. They have created no panic ; they have done no material harm. They have served the nation which is attacked better than they have served the enemy which has struck the blow. People in the cities raided, instead of being terrified, have been strengthened in their determination to see the war through ; while the country which has planned such attacks, as shown in the case of Germany, has exposed itself to the condemnation of the world. Far more shrewd has been the attitude of our British war staffs, both naval and military. They have

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ordered and encouraged bomb-dropping, but only in cases where it might prove genuinely effective. Raids have not been made on cities, and for the reason that the game has not been thought worth the candle. But where an attack could be delivered with telling force—as witness our raids on Zeppelin sheds—our aviators have done bold and successful work.

## IV

### OUR FIRST AIR RAID

*"The importance of this incident lies in the fact that it shows that, in the event of further bombs being dropped into Antwerp or other towns, measures of reprisal can certainly be adopted, if desired, to almost any extent."*—ADMIRALTY REPORT.

OUR naval raids on Düsseldorf and Cologne, the most successful so far achieved, were extremely daring in conception, necessitating flights of more than a hundred miles over an enemy's country ; and they were carried out with a dash beyond all praise. Also they struck the enemy a vital blow. Though only two or three bombs reached their mark—a result that would have been negligible had not the target been vulnerable—serious damage was done.

One needs to consider the motive for these raids, and why it was worth while for our pilots to run the grave risks that such flights entail. The aim was to cripple or destroy German Zeppelins ; not when these craft were in the air, but when they lay housed in their sheds. It had been a disappointment to our aviators in France, as we have mentioned, that

## Our First Air Raid

none of the enemy's Zeppelins were to be encountered in flight. But as a matter of fact, and wisely from their point of view, the Zeppelin commanders confined themselves to night flying, keeping as far distant as possible from the aeroplanes of the Allies. A combat in daylight, with several planes that were fast in flight, could have had but one ending for the airship: a bomb through her hull, the igniting of the gas in her compartments, and a fall to destruction.

But though the Zeppelins were during the daytime lying housed in their sheds, they were not beyond attack. Berthed in huge structures, some large enough for two airships to stand side by side, they were protected well enough from the wind, even though it should blow a gale; and their sheds were so far within German territory that there was no risk of their being exposed to a raid by land. But these sheds, by reason of their size, offered an excellent target for an attack from the air; while their roofs, built of a light metal plating, fixed over girders of steel, promised no effective resistance to an enemy's bombs.

Hence the scheme of our naval aviators: a raid from their base near Antwerp—this was before the city fell—and a dash by air on the sheds at Düsseldorf and Cologne. It must not be thought that the sheds were entirely unprotected. They should, theoretically, have been guarded by a patrol of defensive aeroplanes; and this in addition to riflemen and a battery of

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anti-aircraft guns. In reality, owing no doubt to the demand there was for aircraft in the Eastern and Western theatres of war, the defence was in the hands of artillerymen and soldiers, and there were no aeroplanes by which the invaders could be fought in their own element. Still, even with aircraft absent, the raid was extremely perilous ; and for the reason that, in order to make certain of placing a bomb on one of the sheds, the aviators would need to fly quite low, and so run the gauntlet of the guns which were placed on the shed and on the ground nearby.

On August 27th a small but completely equipped squadron of naval aeroplanes, in charge of Wing-Commander Samson, a flying officer of experience, passed from England to Belgium, via the air, and established a first camp in the neighbourhood of Ostend. After remaining there a short time they flew farther inland, forming several advance posts ; and it was a detached squadron which, on September 23rd, attempted the first of the two raids on Düsseldorf. This flight, however, was not so successful as had been hoped ; the weather proved unfavourable. There was a mist which, while it served to hide the airmen when they were in flight, made it difficult for them, when they neared their objective, to find the Zeppelin sheds, and even more difficult, when they did find them, to drop a bomb with accuracy on their roofs.

The raiders crossed above the Rhine, and found that as they flew the mist grew thicker ;

## Our First Air Raid

it became difficult, in fact, to see landmarks. But they kept on none the less, and reached Düsseldorf. Then Flight-Lieutenant Collet, who was flying a fast tractor biplane, dived boldly from the shelter of the mist and came within a few hundred feet of the ground. Such tactics were dangerous, but he relied on the speed of his craft, and on the fact that the raid was a surprise. Gliding down swiftly from 6,000 feet, he plunged through a belt of mist at 1,500 feet ; then, when at a height of not more than 400 feet, and within a quarter of a mile of the sheds, he came first in sight of them. With a craft that had a speed of more than a hundred miles an hour, it did not take him long to reach his mark. Rushing upon the sheds, still flying low, he dropped three bombs in quick succession and darted away. The defenders, though taken by surprise, managed to open fire. But no sooner had the aeroplane appeared, it seemed to them, than it was out of sight again in the mist ; and the machine was struck only once by the fusillade, and this in no vital part.

Lieutenant Collet, though he escaped, was unable to estimate what damage his bombs had done ; but it was learned afterwards that at least one of them had penetrated a shed, and injured to some extent the airship that lay within ; while the others, falling close to the sheds, had crashed into some workshops and damaged their contents. This raid was, in view of the unfavourable weather, distinctly successful.



## V

### OUR NAVAL AIRMEN DESTROY A ZEPPELIN

*"This incident has produced, in certain circles of the population, a feeling which is not in accord with the energetic and vigorous character of the German people."*—BARON VON BISSING, IN COMMAND AT DÜSSELDORF.

THE second attack on Düsseldorf, made on October 8th, was far more successful than the first, and this despite the fact that the defenders were on the alert. The flight was made in more favourable weather, and three airmen were concerned—Squadron-Commander Spencer Grey, and Lieutenants Marix and Sippe. Each flew a small, high-powered biplane, starting from a point close to Antwerp, where their principal base had been established.

Early in the flight Lieutenant Sippe's motor gave trouble ; then it failed and he had to plane down. The aviator, during his glide to earth, experienced some moments of suspense. He could not locate his exact position on the map, and did not know whether he was over Belgian soil or had passed into the enemy's territory. When he

## Our Naval Airmen Destroy a Zeppelin

reached ground, therefore, and climbed from his machine, he was anxious to see who would first accost him—having an idea it might be a Uhlan patrol. But there was no cause for anxiety. A Belgian woman ran across a field to him ; and the first question she asked was whether he would like breakfast.

Squadron-Commander Grey and Lieutenant Marix continued their flight, and both reached Düsseldorf. But this time they were not unexpected, and were greeted by a heavy fire. It did not deter them. Flying at high speed, they both steered for the Zeppelin sheds. Lieutenant Marix was the first to reach them. He was then at not more than 600 feet, and was in extreme peril from the gunfire, which included rifle volleys and shrapnel shells. One thing alone saved him, and this was his speed. He flew over the sheds and dropped two bombs, then was away at a pace that astonished the Germans. Even so, despite the protection of his speed, his biplane was, in these few seconds, struck no less than twenty times—a sufficient indication of the deadliness of the fire. All the shots, however, passed harmlessly through his planes ; with the exception that is to say of one, which cut a couple of control wires and might have ended his flight. Luckily, however, even with these wires cut, the machine proved controllable, and Lieutenant Marix was able to fly back across the Belgian frontier and land at a point only fifteen miles short of Antwerp. An armoured motor-car

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had been waiting outside the city for the return of the aviators, and this came to his assistance. The spot where he landed was, however, too close to the German lines for it to be safe to attempt to dismantle his craft and take it back to the flying-ground. It had to be destroyed where it fell, so that it should not come into German hands; and after this the airman was taken to Antwerp in the car.

The two bombs he had dropped both reached their mark. They fell on the roof of a shed which contained a Zeppelin, and went through it. Thirty seconds later, rising high in the air, there came a sheet of flame. One or more of the gas-chambers of the airship had been punctured and the hydrogen ignited. This meant that the airship was destroyed—or for all practical purposes destroyed, seeing that it would have been burned until nothing but a skeleton of metal remained. German reports, despite evidence of the igniting of the gas-chambers, denied that the damage was serious. The attack, declared *The North German Gazette*, “was only partially successful.” To substantiate the claim that the bomb did not destroy the airship, it was stated in the German Press that the airship which was attacked, being one of the most modern in construction, had been planned with a view to resist an onslaught from the air. “Precautionary measures,” it was said, had been taken; and although these were not stated, we were led to suppose that, by some

## Our Naval Airmen Destroy a Zeppelin

form of interior mechanism, the shock of the bomb was absorbed, and the envelope of the airship spared from more than trifling damage. It is possible that, between the roof of the shed and the top of the airship's hull, there might be placed some protective device—say in the form of a steel netting. But it seems clear in this case that, even had there been such a netting, Lieutenant Marix's bomb went through it, just as easily as it had gone through the roof. Therefore, in this instance, the "precautionary measures" failed. That the airship was destroyed there seems no question. Apart from the rush of flame that followed the dropping of the bomb, there has been testimony since, from men who were in Düsseldorf at the time, which shows plainly that the bombs did all that they were expected to do, and that the result was far from being "partially successful." This *coup* was excellent: in one flight, and in a single attack, our aviators had destroyed one of Germany's largest airships. The raid demonstrated how vulnerable such craft are, even within the shelter of their sheds.

The best form of protection for an airship would be an underground harbour; but this, naturally, would require a long time for its construction, and would be costly to provide. In an underground shed, protected by an armoured roof flush with the ground, an airship might lie secure from aerial attack. Such sheds would be difficult to locate from above, and even if

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the airmen found them and dropped their bombs accurately, the missiles should prove ineffective against a heavily armoured roof. Fortunately for us, and unfortunately for the Germans, sheds such as these are unavailable in this war ; but in future, as the power of destructive aircraft grows, no airship will be safe unless protected in some way such as this.

So far, in this raid, we have traced the adventures of Lieutenant Marix. His companion, Squadron-Commander Grey, did work which was equally daring, though it did not prove so effective. He had watched, from the air, the attack by Lieutenant Marix on the Zeppelin sheds, and had seen the bombs reach their mark. So he decided to carry his own missiles farther afield, and flew in the direction of Cologne, where there is another airship station. But as he neared this city the air became misty, and he was unable to find the Zeppelin sheds. Rather than have a wasted journey, he passed over the city, under fire, and descending to within 600 feet, dropped his bombs on the central railway-station. His biplane, like that of Lieutenant Marix, was struck by the gunfire from below ; but the damage was not serious, and the airman returned safely to his starting-point, having made a  $3\frac{3}{4}$  hours' flight over the enemy's country. The damage his bombs did at Cologne was stated in an Admiralty report to have been "considerable."

It is instructive, in regard to this Düsseldorf

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raid, to note that the people of the city were greatly perturbed ; and it was the speed at which the attack was carried out which proved so disconcerting. It was shown that, with high-speed machines, even when they are flying low and above a point that is well guarded, there is great difficulty in crippling them or bringing them to earth. The best manoeuvre, from the aviator's point of view, is to fly high until he is near his objective ; then to dive down over it, launch his bombs, and make his escape as quickly as he can, with erratic movements of his machine.

## VI

### THE GERMAN RAIDS

*"The more unmerciful the conduct of the war, the more merciful it is in reality, for the war is thereby sooner ended."*—GENERAL VON HINDENBURG.

THE raids on airship sheds, as achieved by our naval aviators, show bomb-dropping at its best—at any rate so far as this war is concerned ; and the German attacks upon Antwerp, Paris, and the east coast of England, show, on the contrary, how futile, and worse than futile, such raids from the air may prove.

Against Antwerp, in the earliest stage of the war, the Germans used their Zeppelins ; but they had not sufficient craft available to make their attacks effective ; and even at night, if they are raiding an armed city, these large machines have awkward limitations. Here, as always, their bulk is against them. There is no chance for them, as there is for the aeroplane, to dive within a few hundred feet of the ground. They would, were they to do so, be crumpled instantly by gun-fire. Their only hope of escaping destruction is to fly high ; and from these altitudes,

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even though the airship offers a better platform for bomb-dropping than does an aeroplane, it is difficult to place a missile on any given spot. The airship can hover above its target, though this feat is easier in theory than in practice. Wind has to be reckoned with, blowing often in fluctuating gusts, and these have an erratic influence on the machine. It is dangerous too, when an airship is under fire, for it to remain motionless. Even when it is moving it offers a large target ; and when it is stationary the gunners have, of course, a far better chance of hitting it.

In the matter of speed the airship, even when at its maximum, compares unfavourably with the aeroplane ; and this point is important, as has been shown, when gunfire is considered. A Zeppelin at full speed will fly at about fifty miles an hour. In special tests a speed of sixty miles an hour has been attained. But this is very different from, say, the hundred miles an hour that is possible with the aeroplane. In the latter case you have a small object, travelling at immense speed, and able to dart here and there ; while with the airship there is a huge hull, more than 500 feet in length, which is passing through the air at half the speed of the aeroplane. And one well-placed shell, in any part of its frail body, will put it out of action. It is not surprising that Zeppelins shun the light of day, and have to be handled with caution even when they fly at night.



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An obvious precaution for their pilots would be to fly so high that they would be out of range of guns; but, were they to do this, they would have small power as weapons of destruction. Even from 6,000 feet, the approximate height from which they have operated in this war, their bombs have fallen at random. And the Zeppelin, even if she wishes to fly high, is limited inexorably by the expansion of gas in the compartments within her rigid hull. The height record with a Zeppelin has been registered at approximately 10,000 feet; that seems the limit with machines as at present designed. And it must be remembered that with the most powerful of the anti-aircraft guns, as employed in this war, it is possible to throw a shell to an altitude considerably greater than this. The Zeppelin is not able to attain such an altitude as 10,000 feet unless by a special effort, and by a discharge of ballast. Ordinarily, even when on a raid, her height may be reckoned as between 6,000 and 8,000 feet. So she is not likely to evade gunfire by high flying. What she must do is to steal above her position at night, drop her bombs by way of a surprise, and get away as soon as she can before search-lights locate her, and before the gunners have been able to determine her range.

At Antwerp, in the first of the Zeppelin raids, this was indeed the programme adopted. The airship came by night, and was unseen till she was over the city and had begun to drop her

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bombs. Then the searchlights flashed in search of her, and there was a roar of gunfire. But she had the tactical advantage, and managed to make her escape. This raid, however, and the others which followed, were really not worth while. The Zeppelin dropped powerful bombs, which were charged with picric acid, and they wrecked some houses and killed and wounded some people. But the aim of the bomb-droppers was utterly at fault. Instead of being concentrated on given areas, such as military depôts or railway-stations, bombs fell here and there without method; some went so wide even that they fell beyond the city. There was no panic among the people. With one airship, and with these few bombs, the Germans could scarcely have expected to achieve a definite result. The Zeppelin discharged her bombs and escaped, that is true; but she might just as well not have come—except that she proved, perhaps as conclusively as could be, the futility of such sporadic attack.

Had the Germans been able to muster, say, a dozen Zeppelins for this attack on Antwerp, and had they acted on a concerted plan, and dropped their bombs with precision, then a great deal of damage might have been done, and the people might even have been driven in a panic from the city. Germany possessed a dozen large airships at the beginning of the war—even more; but they were scattered over the country at various stations, and to bring them together over Ant-

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werp at any specific time, and on any given night, would have been a matter of great difficulty. These machines, one must remember, are virtually chained to their sheds ; they must, that is to say, be able to return to them after a flight. Unlike the aeroplane, which can make a landing anywhere, provided the ground is reasonably smooth, the airship requires the services of a large and highly skilled landing-party ; and in a gusty wind, unless there is ample tackle for handling her, and unless she can be taken quickly into her shed, she may become unmanageable and wreck herself against the ground. Besides the fact that her airships were scattered, and could not very well be concentrated at any given spot, the Germans required them, of course, for a variety of purposes. There were observation flights to be made by night, not only in the West but in the East ; therefore all the machines could not be spared in any one direction. The airship which attacked Antwerp came either from Düsseldorf or Cologne ; both these stations lie within about a hundred miles of Antwerp.

Attempting to repeat its raid, the Zeppelin met with a warm reception. It was detected by searchlights and subjected to such a murderous fire that it had to curtail its programme and fly out of range. Several bombs were dropped, however, and some people injured ; but again the raid did no more than evoke a storm of protest. And at a subsequent attempt, the defenders being now on the *qui vive*,

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the airship was forced to turn away by gunfire before she could drop a bomb.

The Antwerp raids do not prove conclusively that airship attack is ineffective. They represent a new phase of war. Aircraft had never been used before for such a purpose. The Zeppelin commander had had no experience; and the bomb-dropper in the machine, though he had practised beforehand against dummy targets on the ground, or in the sea, was using an experimental weapon; and between peace practice and the conditions imposed by war there is usually a vast difference. With only one airship employed, and her crew quite new to such work, there was little chance that the raid would prove successful. Those who organized it must have hoped for a public panic; but in this, as has been shown, they were disappointed.

The Zeppelin, as a type of destructive craft, should not be condemned out of hand. With everything in its favour, and with, say, six or more machines employed on the same raid, results unpleasant for an enemy could be achieved. A cloudy night must be chosen, and craft must fly high. With motors silenced, they must aim to reach their objective, and drop the first bomb, before they are detected by the searchlights of a city. Then, the missiles discharged, they must scatter and make off through the darkness, eluding if possible the armed aeroplanes which will pursue them. The point in favour of the airship, in such destructive raids,

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is that she can do work which is impossible at present with the aeroplane. A night flight, from German air-stations to London and back, is feasible should the weather prove favourable, and a period of the year be chosen in which the nights are sufficiently long to permit the airships to make their out and return flights during the hours of darkness.

The Zeppelin raid on our East Coast, made on January 19th, told us practically nothing we did not know before. That such airships could reach our coasts, while under cover of darkness, was understood; also that, if conditions favoured them, they might be able to drop bombs and escape seaward. The raid threw no light on the problem that is vital: Can such aircraft, by making a night flight, deliver an attack that is successful on a city prepared for attack—a city with searchlights and high-angle guns, and with aeroplanes ready to ascend and give battle to the raiders in their own element?

When it reaches its point of attack, the airship can drop formidable bombs. It is possible for a Zeppelin to discharge a missile weighing several hundred pounds; and such a bomb, loaded with a special explosive, may—as has been shown—do a great deal of damage when it reaches the ground. With the largest rigid airships there is a capacity to carry, even when burdened with fuel for a long flight, a load of bombs of from two to two-and-a-half tons in weight. This means that, if six vessels are engaged in a raid,

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they can drop twelve tons of high explosives on a city.

But there are many factors to be considered in a Zeppelin raid—weather, distance, the manner in which the craft are handled, the alertness and armament of the city that is attacked. In an attack, say, on London or Paris, there would not only be guns and search-lights to reckon with, but swift, vigorously handled enemies in the air, using bombs and machine-guns, and flying at a far greater pace than the raiding craft. But the problem of a combat between airship and aeroplane, which is interesting, may be dealt with more adequately at a later stage of our book.

American experts, viewing the problems of large airships with the shrewd eyes of the on-looker, have reached conclusions unfavourable to such craft. General Scriven, Chief Signal Officer of the United States Army, in a report to the Secretary of War, has stated—

“ These Dreadnoughts of the air can be used for offence . . . only in such infrequent and exceptional conditions that their construction under present conditions must be pronounced undesirable.”

European advocates of the airship will not agree with this view. They hold that, so far as this war is concerned, the airship is not sufficiently perfect to be judged as a weapon of destruction. It is possible of course to build craft

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which shall be larger and faster in flight than any of those at present used. Such machines would be able to carry a more formidable armament, and ascend to greater altitudes. But these are matters of the future. For the present, and during this war, the airship is handicapped sorely by her size and her slowness; and General Scriven is justified in his view that success in any raid can be obtained only under conditions which are "infrequent and exceptional."

We should not, in justice to other types of lighter-than-air craft, forget to mention the excellent work—quietly and discreetly done—of French and British airships. These machines, which are of the semi-rigid and non-rigid type, and are considerably smaller and more easily handled than the Zeppelins, have rendered capital service in their patrol flights. The British naval airships, few in number but admirably flown, have scouted constantly over the North Sea, often in difficult weather. They were much in evidence, for example, during the crossing of our Expeditionary Force, keeping a look-out for enemies both by land and air. The French airships, also, flown so dexterously that they have avoided hostile planes, have made long reconnoitring flights, both by night and day.

## VII

### THE AEROPLANE ATTACKS ON PARIS

*"As to the bombs, I am infinitely sorry; but 'c'est la guerre.'"*

MESSAGE FROM A GERMAN AVIATOR.

So far, in regard to raids on cities, we have dealt only with the attacks by airship. But the aeroplane is a factor to be reckoned with, though its radius of action is less, and it cannot raise such a heavy load of explosives. But it has speed in its favour, and offers a small target for artillery. As the Germans have shown in their raids on Paris and Dunkirk—and as we have shown them in our raids on Cuxhaven and Cologne—it is possible, even in daylight, for an aeroplane to pass over a city, drop its bombs, and escape without being destroyed. For an airship to attempt such a feat, during the daytime, would be to court destruction.

The German aeroplane raids on Paris, like the airship raids on Antwerp, produced no tangible result. But they were daring in their conception, and carried out with courage and skill. The most important of the raids, of which there were several, took place on October 11th, when



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two German aeroplanes appeared over the city at midday and dropped twenty bombs with great rapidity. Four people who were in the streets were killed outright, and a number wounded, by flying fragments of the bombs, while one of the missiles, falling on the church of Notre Dame, did a certain amount of damage to the roof. Fire was opened on the raiders, but they were flying high and made off so quickly, after their bomb-dropping was done, that they evaded French aeroplanes which rose in pursuit. In a subsequent attack, in which one Taube passed over Paris and dropped six bombs, the point aimed at was evidently the Gare du Nord. One bomb, indeed, reached its target, crashing through the glass roof and falling on a platform below ; but it did no serious harm, though it exploded between a couple of railway coaches.

The pilot who made this raid, describing his impressions afterwards in the *Frankfurter Zeitung*, said :—

“ It was an impressive sight, this gigantic town underneath, like a big map. There the Eiffel Tower ; there the Madeleine ; there the Place de la Concorde ; and there the Dome of the Invalides—where reposes the greatest general France ever had.

“ Suddenly it seemed to me as if the entire traffic, and all the life of this metropolis, had been cut off. The electric cars stopped suddenly, while motor-cars and other vehicles stood still. Pedestrians looked up into the sky. The eyes of all Paris were watching me.”

## The Aeroplane Attacks on Paris

After the first raid the French authorities, apart from the defence provided by anti-aircraft guns, had organized a patrol of armed aeroplanes ; and on the occasion of the second attack, when the Gare du Nord was struck, five French aircraft rose to pursue the Taube. But its pilot was discreet and refused combat, flying eastward in the direction from which he had come.

Thereafter, so as to deal with these aerial raiders—though machines were ill-spared from the front—the French maintained a constant patrol above Paris, using powerful machines which carried a pilot and a combatant, the latter armed either with a rifle or a light form of machine-gun. The existence of this patrol, as many as six machines being in the air at the same time, put a check on the German raids. Hostile craft, it is true, approached the city, but they did not dare to run the gauntlet of these armed and waiting craft.

There were, during the raids on Paris, some extraordinary escapes from death. In one case, in an office, a man sat at a typewriter. Suddenly a German bomb fell on a balcony outside the window. It burst with a tremendous report, breaking in the window, cracking the walls of the room, dashing the furniture to fragments, and wrecking completely the typewriter at which the man sat. Yet, though he was thrown violently to the floor, he escaped uninjured.

There was one humorous aspect also to the raids. It concerned the elderly fishermen who,

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reminding one of De Maupassant's story, "Deux Amis," were so engrossed with their sport that even war would not keep them from it, and gathered daily in long lines upon the banks of the Seine. During one of the air attacks, vastly to their indignation, a bomb fell in the river and exploded not far from where they stood; and this, of course, played havoc with their sport, the fishes that were not killed outright being frightened away. The old anglers, however, were not put to flight. They held their ground and continued to watch their floats. But it was no good; there were no more catches that day. Whereupon, gathering in his tackle gloomily, one observed to another—

"But what can one expect? These Boches! Just as the fish begin to bite, they drop their bombs in our river. It is unsportsmanlike—most! But then they are barbarians!"

The most effective aeroplane raid made by the Germans, up to the end of 1914, was delivered against Dunkirk on the morning of December 30th. Five machines were employed, four of them dropping bombs, while the fifth—maintaining a high altitude—kept watch for the arrival of any hostile craft. None appeared; the Allies had no machines in the locality at this particular time. The defence, therefore, had to be carried out with rifles and machine-guns; but the German aeroplanes flew so high that this land-fire was ineffective.

## The Aeroplane Attacks on Paris

The four attacking machines dropped thirty bombs. These did damage to property, while twenty persons were killed in the streets and thirty-eight injured. The greatest damage was done by two bombs which fell close together near the Town Hall. The shock of the explosions struck down every one who was standing within twenty yards of the spot.

On January 10, 1915, there was an even more determined attack on Dunkirk. A dozen German aeroplanes were concerned, and they were estimated to have dropped nearly 50 bombs. The raid, apart from some trifling damage to property, resulted in the loss of six lives—those of a soldier, a Red Cross worker, and four civilians.

## VIII

### OUR RAID ON FRIEDRICHSHAFEN

*"A fine feat of arms."*—ADMIRALTY REPORT.

EXCELLENTLY organized ; admirably carried out ; such was the air raid on Friedrichshafen, which took place on Saturday, November 21st. This was the third and the most successful of our aerial invasions of Germany ; and again it fell to the lot of our naval aviators, who had mobile and detached squadrons in France, to plan and execute the flight.

Friedrichshafen is well worth attacking. Lying on the banks of Lake Constance, protected against everything save air attack, it is the home and birthplace of the Zeppelin airship. There are two places, indeed, which are treasured in the German mind. One is Essen, where Krupp guns are built ; the other Friedrichshafen, where Count Zeppelin established himself in the early days of aviation, and where the first of his rigid-type airships was launched upon the lake from its floating shed.

The works at Friedrichshafen have, since the beginning of the war, been busy night and day.

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Alongside the main shed, which will hold two airships berthed side by side, has grown up a row of factories; and in these buildings, with special tools and material, and by the work of skilled men, are built the delicate frameworks of the Zeppelin craft. It was in 1908-9, after a series of disasters which had exhausted completely his private fortune, that Count Zeppelin was presented by the German public with a subscription of £300,000; and this sum, which was to be devoted to his future work, enabled him to build the air-station at Friedrichshafen, and embark on the construction of larger and more powerful machines. A picturesque figure in Germany, and one of the most ardent and sincere, Count Zeppelin is convinced that the rigid-type aircraft has an important future. Never for a moment has he hesitated in this faith; accidents have merely spurred him to a more eager effort.

At Friedrichshafen, after the outbreak of hostilities, new Zeppelins were under construction—machines more formidable than any that existed before the war; craft which would fly higher than their predecessors, and faster, and carry greater weights. The knowledge that these machines were being built, and that the factory on the banks of Lake Constance was working night and day, gave rise naturally to the suggestion that, were bombs to be dropped on it from the air, they might interfere seriously with its busy routine. Hence the planning of the raid by our naval aviators, who had gained experience in

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their attacks on Düsseldorf, and were eager to distinguish themselves in some further exploit.

In this attack on Friedrichshafen, more than in any preceding scheme, there lay need for detailed organization. It was vital to the success of the raid that it should come as a surprise ; but this was not easy to ensure, seeing that spies abound near the frontier in France, and that it would be from some point on the frontier that the air-raiders would need to start. To reach Friedrichshafen at all, by way of the air, was no simple problem. It would mean, from any of the points where British forces were operating, a flight of more than 250 miles over difficult and hostile country ; and such a distance, when a return flight was considered, represented a task which, while not being impossible, offered too many risks of failure. When maps were consulted an easier route was seen. The raiding aeroplanes might be taken to Belfort, complete secrecy being preserved, and launched from there on their flight to Friedrichshafen. Belfort lies near the Franco-German frontier, close to the point where it makes contact with that of Switzerland ; and from Belfort the aviators could follow the course of the Rhine, skirting the German-Swiss frontier, and reaching Lake Constance in a flight of 120 miles. This entailed a return journey of, say, 250 miles—an arduous undertaking for the pilots, and one full of risk, seeing that they would be passing over hostile country,

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and above land that was mountainous and unsuitable for a descent.

The raid was well prepared. No breath of news leaked across the frontier. The Germans knew nothing, obviously, of the blow that impended. Had they done so—had they known the raiders were assembling at Belfort—they would no doubt have obtained aeroplanes, as well as guns, for the defence of Friedrichshafen. Had there been armed aeroplanes to guard the factory and shed, craft which could harass the enemy as they approached, it would have been far more difficult—it might, indeed, have been impossible—to drop bombs with accuracy. But there were no defensive aircraft. There seems indeed little doubt that, until there came a hasty message from Constance, saying the raiders were already above the lake, the garrison at Friedrichshafen was unaware of the peril by which its charge was threatened.

The morning chosen for the raid was fine, but there was a ground mist ; and in places along the banks of the Rhine this mist was lying heavily, making it difficult to see landmarks. But it had the advantage of helping to conceal the aircraft, as they passed on their way.

Three pilots were, as in the case of the Düsseldorf raids, chosen to make the flight. All flew the same type of craft—a small, light, single-seated “Avro” biplane, engined with a motor of 80 h.p. This machine, apart from being fast in flight, was quick in control—a point of im-



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portance for the pilot when manœuvring for the dropping of bombs.

The first to start from Belfort, just before ten o'clock, was Squadron-Commander E. F. Briggs, a pilot of exceptional skill, who has studied the science of aviation, and has been a member of the naval air service since the foundation of the flying-school at Eastchurch in 1912. The second to ascend was Flight-Lieutenant Sippe, whose name is familiar in connection with the Düsseldorf raids. He is an aviator of experience, having handled machines of many types and flown in many countries. The third air-raider was Flight-Commander Babington, a pilot accustomed to the handling of higher-powered machines.

The aviators carried, in addition to their bombs, a full load of fuel, and rose steadily to an altitude of 5,000 feet, heading towards Basle, on the Swiss frontier, a first stage in their flight that represented a distance of thirty miles. Here they were seen distinctly. All were, in fact, flying low, having descended to make sure of their direction. Then they passed along the Rhine, keeping well on the German side, and with Swiss territory to their right. So they flew, gradually losing sight of each other, until Schaffhausen was reached. Here the river curves to the right, and from this point to Friedrichshafen is a distance of no more than forty miles.

Commander Briggs, still flying first, was misled at Schaffhausen by the mist. Instead of following the curve of the river to the right,

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he flew straight on, and for the time being lost his way. But Lieutenant Sippe, following close behind him, although the two airmen were invisible to each other, adhered to a correct course and followed the track of the river; so did Flight-Commander Babington, who was bringing up the rear.

Lieutenant Sippe, flying smoothly and accurately, came in sight of Lake Constance at a point near the town of Constance; and here it was that the airmen were observed, and a warning sent across to the Zeppelin works. But the lake is less than fifteen miles wide at this point, and, with aircraft that fly at nearly a hundred miles an hour, the attack came quickly upon the heels of the warning.

A mist shrouded the surface of the lake, and Lieutenant Sippe descended until he was flying very low. Then he sighted the roofs of Friedrichshafen, and passed rapidly above the town, still flying low and being greeted by a splutter of fire. Ignoring this, he flew steadily on, and in a minute or so came in sight of his goal—the shed and factory of the Zeppelin works. Above them, greatly to his surprise, he saw an aeroplane, and recognized the machine as being that of Commander Briggs. The latter had corrected his course quickly, after the error at Schaffhausen, and had arrived first on the scene, being busy already with his bombs when Lieutenant Sippe appeared.

The latter saw shells bursting around his com-

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panion's machine. The gunfire was exceptionally heavy. On the roof of the shed there were machine-guns ; while from points of vantage near the factory, and also from boats on the lake, there were anti-aircraft guns throwing shrapnel-shells, which maintained a constant fire. Sharpshooters also, standing together in squads, fired rifle-volleys upward. Commander Briggs admitted afterwards that the German fire was "devilish good" ; and it seems clear that, in order to give Friedrichshafen the fullest protection, specially picked gunners had been drafted there from the front—men, that is to say, who, after handling their guns for weeks against the aircraft of the Allies, had become skilled and experienced in this difficult work. One fact, at any rate, is certain : the gunfire at Friedrichshafen was far more accurate than that which had greeted our raiders at Düsseldorf or Cologne.

Commander Briggs, determined that his bombs should reach their mark, made a dash above the factory, flying low. A tremendous fire greeted him, bullets and shrapnel-shot penetrating his planes. But at first no vital part of his machine was struck, and he dropped several of his bombs. Then, unluckily for him, a chance shot found his petrol-tank. This was pierced, the fuel began to flow away, and his motor stopped. There was now only one thing he could do, and this was to descend—although, of course, it meant capture. But even as he planed down, with no prospect save that of falling into the enemy's

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hands, he did not forget that his mission was one of destruction. Knowing well that his act must arouse the fury of those below, and knowing, too, that in a moment he would have to alight among them, he steered a path low above the factory roof, and dropped his remaining bombs upon it from a height of less than 100 feet. That they reached their mark is certain, though in German reports this has been denied.

Gliding on past the factory, his power of destruction spent, Commander Briggs landed within a hundred yards of it. His machine, save for the puncture of the petrol-tank, was practically undamaged. Exactly what happened, immediately following his descent, has not been made clear. Certainly a crowd rushed up—composed probably of factory hands, enraged at the damage he had done. Their attitude obviously was threatening, and the airman drew his revolver to defend himself. He received a wound on the head—how has not been stated; but then soldiers appeared, and he surrendered to the officer in charge. This officer behaved extremely well, sending a telegram to London announcing that Commander Briggs was not seriously hurt, and adding words in appreciation of his courage and resource. Then the injured aviator was taken to hospital, and his gallant part was done.

Meanwhile the other two pilots were dropping their bombs on the factory. Their machines were hit repeatedly, but still they kept the air. Not until all their bombs were gone did they

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turn back the way they had come, alighting finally at Belfort more than four hours after having left it. Their biplanes, when examined, revealed the violence of the gunfire through which they had passed. Upon the main-plane of one, from back to front, was drilled a succession of neat bullet-holes—each puncture being close to the next, and all in an orderly row. This showed where some machine-gun, spraying a rain of lead into the air, had found its target for a moment and swept its fire across the machine. Luckily the bullets missed the body, and failed also to cut important wires.

The two aviators who returned were able to report that, beyond any question, all the bombs dropped—they numbered eleven—had “reached their objective.” The Admiralty issued subsequently a memorandum, by the Director of the Air Department, in which it was stated :—

“ It is believed that the damage caused by this attack includes the destruction of one airship and serious damage to the larger shed, and also demolition of the hydrogen-producing plant, which had only lately been completed. Later reports stated that flames of considerable magnitude were seen issuing from the factory immediately after the raid.”

The attack was certainly a success, and provided an example of what may be done, even with such craft as are now available, and with the crude means that exist for dropping bombs, in the delivery of a long-distance air raid on a vulnerable point.

## IX

### THE SEA-PLANE ATTACK ON CUXHAVEN

*"The Bight of Heligoland is 300 miles from the nearest point of the English coast. Its waters and its shore are heavily defended. The ports within it are, on paper, among the strongest naval bases in the world. . . . Only one way is open for direct attack—the way of the air."*—"THE OBSERVER."

A FEAT of airmanship that will have an historic interest was the naval raid on Cuxhaven, made on Christmas Day. There was fighting, not only on the surface of the water and below it, but also in the air; and it was this fact—the waging of the combat on three planes—that made the raid unique in war.

Cuxhaven, a German naval base, lies at too great a distance from our east coast for a sea-plane attack on it to be made, with any reasonable chance of obtaining results, by machines leaving, say, the Harwich or Yarmouth air-stations. The total flight entailed—one of six hundred miles—would not be impossible; but it would necessitate an exceptionally heavy load of fuel, and this would limit appreciably the weight that could be raised in the shape of

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bombs. Pilots would be exposed to a serious risk from engine failure, when making so long a flight over open sea. There would be difficulty, also, in timing such a raid, were attacking craft to start from the English shore. In order to strike their blow just after daylight, which would be the most favourable time from the point of view of a surprise, sea-planes would need to leave an East-coast station at some hour in the night ; and a long flight over-sea, during the hours of darkness, would represent a period of nerve-strain and anxiety for the pilot of a machine ; although, if there were no side winds to trouble him, and he had several compasses in his machine, so that he could check one against another, it should not be impossible for an aviator to cross above the North Sea by night, and reach the opposite shore in some given locality, with a reasonable degree of accuracy.

But, as a matter of fact, a better method suggested itself. It was decided that the sea-planes should be taken across the North Sea in transport-ships prepared for the task, and launched on their raid at a point within a few miles of the German coast. The machines would, by the adoption of this plan, be able to carry a maximum weight of bombs. Their attack delivered, it was arranged that the craft should return seaward, alight if possible near the ships from which they had started, and be raised again on board. To escort the sea-plane transports, and protect them if necessary from attack, several

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fast cruisers were detailed for service ; and to them, completing the squadron, were attached some torpedo-boat destroyers and one or two submarines.

The sea-plane, as we have shown already, is, in its present stage of development, and so far as riding on the water is concerned, more or less a fair-weather craft ; it cannot withstand the shocks of a succession of heavy waves. Therefore it was necessary for the squadron, after it had been formed, to await a calm and settled spell of weather. This, seeing that the month was December, naturally entailed delay. But two or three days before Christmas the wind died away almost entirely, and the North Sea fell surprisingly calm. So on Christmas Eve, under the cloak of darkness, the squadron left the English shore.

A little before daylight, having navigated the Heligoland Bight and avoided the German mine-fields, the transports and their escorts were within a few miles of Cuxhaven and the mouth of the Elbe. Here the transports swung the sea-planes from their decks and lowered them into the water. Unfortunately, however, though it was almost unavoidable in such weather conditions, a mist hung over the sea. Nine machines were launched upon the water ; but the motors of two proved refractory, and in the end only seven flew shoreward on their raid. The craft used were all of the same type—large biplanes, each with a motor of 200 h.p.



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The seven machines moved across the water and rose quickly, steering towards the roads just outside Cuxhaven, where lay some German war-ships. The object of the raid was to attack these, and also to fly inland and drop bombs on the gasworks and other places that were vulnerable. It was at this juncture probably, detecting the approach of the sea-planes out of the mist, that the Germans became aware of the menace by which they were threatened. Submarines, aided by a number of sea-planes and two Zeppelins, moved out to attack the raiders. The German sea-planes, flying over our ships, dropped a number of bombs; but their difficulties in aiming were great, and the missiles fell wide of their mark. Against the two Zeppelins, as they approached, our cruisers opened fire with high-angle guns, placing shells so near the airships that they rose to a greater altitude and moved out of range. The circumstances of the encounter were unfavourable for them, and they were present more as scouts than as combatants.

The sea mist, which grew very thick, rendered the action spasmodic, confusing, and without definite issue. It prejudiced, also, the operations of our raiding sea-planes.<sup>1</sup> One satisfactory fact,

<sup>1</sup> An exploit that exceeded in magnitude anything attempted previously during the war was the raid of our aviators—as reported by the Admiralty on the evening of February 12th—on positions of naval importance held by the Germans along the Belgian coast. The official report of the raid was as follows :—

“During the last twenty-four hours combined aeroplane and sea-plane operations have been carried out by the Naval Wing in the Bruges, Zeebrugge,

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however, was that there was no loss of life among the aviators concerned. All seven, having made their flight and dropped their bombs, were able to escape seaward. Six were picked up by destroyers or submarines; although, in regard to the aviators taken off by the latter craft, their planes had to be abandoned and sunk. Flight-Commander Hewlett was, when the squadron headed towards England, the only aviator missing; and he, it appeared afterwards, having lost his way in the mist, and being compelled to land on the water from engine failure, had been rescued by a Dutch fishing-boat. This entailed for him a landing in Holland, and a day or so's delay before he could return to England. But, being classified officially as a "shipwrecked mariner," he was not interned.

Blankenberghe, and Ostend districts, with a view to preventing the development of submarine bases and establishments.

"Thirty-four Naval aeroplanes and sea-planes took part.

"Great damage is reported to have been done to Ostend Railway Station, which, according to present information, has probably been burnt to the ground: the railway station at Blankenberghe was damaged, and railway lines were torn up in many places. Bombs were dropped on gun positions at Middlekerke, also on the power station and German mine-sweeping vessels at Zeebrugge, but the damage done is unknown.

"During the attack the machines encountered heavy banks of snow.

"No submarines were seen.

"Flight Commander Grahame-White fell into the sea off Nieuport and was rescued by a French vessel.

"Although exposed to heavy gunfire from rifles, anti-aircraft guns, mitrail-leuses, etc., all pilots are safe. Two machines were damaged.

"The sea-planes and aeroplanes were under the command of Wing Commander Samson, assisted by Wing Commander Longmore and Squadron Commanders Porte, Courtney, and Rathborne."

## X

### THREATENING THE BRAIN OF AN ARMY

*"The more that clear-sightedness and intellectual influence upon the course of a battle is demanded of a Commander, the more he must keep himself out of serious danger to life and limb."*

GENERAL VON DER GOLTZ.

To add to their anxieties in this war, as though these anxieties were not enough, Headquarters Staffs have been faced by a peril that is new and strange, and has—despite the secrecy of their movements—shadowed them by a menace that is nerve-trying and never-ceasing. This danger, undreamt of in any previous campaign, is that of an air attack.

Snugly though it may be tucked away, perhaps in the inn of a sleepy village, miles behind the fighting line, a modern Headquarters cannot feel it is secure. There are spies whose activity is abnormal, and whose cunning seems almost superhuman. It is worth running almost any risk, too, if a blow can be struck at the Headquarters of an army. In old days this was almost impossible ; but to-day, owing to the existence

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of the aeroplane, it is not. Far to the rear of its troops though the Staff may place itself, and drastic though its steps may be to keep its location secret, there is always this lurking element of risk. Some spy may be bolder and more successful than the rest; a message, and at the sacrifice perhaps of men's lives, will creep through to the enemy's lines; and then one morning just after dawn, with a sudden drone of engines in the sky, there will come a rain of bombs upon that sleeping village inn, and a great army will be in peril of losing the brains that guide it.

In old days, with small armies and short battle-fronts, the Commander-in-Chief, when posted on a hill as was Napoleon at Waterloo, could see all he wanted to see of the movements in the field. Nowadays, with a front extending more than two hundred miles, and with half a dozen separate battles all being conducted at the same time, it is useless for the Commander to rely upon the human eye. If he went to the front he could see only a fragment of the battle, and this might confuse him, and cause him to lose his sense of proportion. So he and his Staff stay far behind the heat of conflict, often beyond sound of the guns. They have their maps, their reports; and the vision of the Commander, as he plots and plans, is not confined to one stretch of country, but takes in at a glance, as the flags on his map are moved here and there, the whole tenor and scope of

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some mighty scheme of arms, in which millions of men are involved and which may take weeks for its unfolding.

Besides the need for preserving his sense of proportion, a Commander-in-Chief must do nothing to risk himself. No haphazard shell must be allowed to imperil the controlling brain. "In war," Napoleon has told us, "men are nothing; it is one man who counts." But what of the scene that took place near Dixmude—perhaps one of the most dramatic of the war? Here, driven from a point near the sea by the fire of the British naval guns, the German Headquarters Staff had chosen a quiet and charming château, in a thickly wooded park, and had installed themselves with their maps, clerks, and baggage. The spot was well screened; it seemed perfectly safe. But the Allies have secret sources of information, as well as Germany with her multitude of spies. This château was located; it was pricked accurately on a map; and tidings were sent through to a French air-base which has been established not far from Dunkirk. And so one day, with many bombs among them, a squadron of biplanes and monoplanes took the air.

It was afternoon at the château. No sound of warfare could be heard. In the largest of the rooms, on the walls and tables, were spread the maps of the Staff. In adjoining rooms officers sat at tables which were loaded with papers; and from other rooms came the "tap-

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tap " of typewriters ; while in other rooms again, with wires festooned through their windows, were the telegraphists who were flashing orders to the battle-front beyond.

Suddenly there was a sound in the air—a dull, sleepy drone, which rose with astonishing quickness to a loud and angry roar. There was a clatter in the courtyard of the château ; a shout of alarm ; the wild discharge of a few rifles. But there was no time for anything in the nature of an organized defence. Over the tree-tops, one behind the other, and flying fast and low, came the attacking aeroplanes—the roar of their motors filling the air. Straight across above the château flashed the first, disdaining the splutter of the rifles of the guard. From it, just at the right moment, dropped a bomb. The aim was true. The roof of the château was struck ; there was a dull and heavy report. Slates fell pell-mell upon the soldiers below ; pieces of masonry toppled into the courtyard. And the next moment, near the gaping hole the first bomb had made, there fell another and another as the aircraft swept above their mark. The roof of the château split asunder ; part of it fell in a cloud of dust and revealed the shattered rooms within.

And out of the doors, hatless and breathless, rushing across the lawns, came the members of the Headquarters Staff. Bombs fell near them, tearing holes in the turf. The building behind them was now flames. At top speed they ran, and darted among the trees ; and not far

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behind them—a sense of duty strong upon them in spite of the demoralization of the alarm—rushed officers who carried with them, fluttering as they ran, armfuls of maps and papers.

Under the shelter of the trees, like rabbits, scurried the Generals and their Staff, and vanished from the view of the bomb-droppers above. It was this wood which saved them. The airmen turned and swung in circles, and the bombs fell here and there; but though the château burned, the quarry had gone to earth. And, as the land-fire grew in intensity, and weapons more powerful came into play, the attackers had to fly higher and eventually to dart away. But it was some time before the Staff dared emerge from the trees; and when they did so they surveyed, with rueful eyes, the blazing roof of the building that had been their abode. Such an alarm, besides, is not good for the nerves; it shakes the equanimity even of a Headquarters Staff—in addition to making a muddle of maps and official papers.

Aviators, as may be imagined, enter with zest into these raids on Headquarters. The game is high—the highest they can play. Should they succeed they may, as an American journalist has put it, “blow out the brains of the enemy.” Picture the consternation, sweeping in waves among the German hosts, should the news be received that, through the daring of a single airman, following the report of a spy, the Emperor William himself had been struck by

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a bomb ! No wonder Imperial Headquarters has been moved with a profound secrecy, and that all the news concerning it which has leaked out has been designed artfully so as to deceive those who might receive it. No one has known where the Emperor has been. His soldiers have not known ; the public has not known ; certainly the Press has not known. And wherever he has gone, by train or motor, precautions against air attack have been many and complete. Near the buildings which have housed the Emperor there have been special anti-aircraft guns, manned day and night. Squads of sharp-shooters have been on duty also—all picked men with the rifle. Two or three aeroplanes, at least, have been housed in sheds within easy call ; and in these, should an attack from the air come, would ascend pilots carrying passengers with a rifle or machine-gun. When available, too, as a completion of the scheme of defence, a Zeppelin has patrolled the air above.

But the chief safeguard of the Emperor has not been guns, or flying craft, but the fact that his quarters have been unknown to the Allies. Once only, in fact, has he seemed in any sort of peril from an air attack ; and even in this case the data are vague. The incident took place at Thielt, where the Emperor had come to discuss with his generals the battle scheme in Flanders. The German Staff had been established for several days in a hotel in Thielt, and the Kaiser arrived one morning at half-past eleven—



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nothing as to his movements being known until the last moment. He stayed to lunch with the Staff and left at half-past one ; and it was at a quarter to two that a hostile aeroplane arrived—a monoplane, which, after circling for a short time, dropped a bomb that was aimed at the hotel which lodged the Staff. It did not hit its mark, however, but fell on the roof of a house near by. The force of the explosion was so severe that slates were ripped from the roof of the hotel, and a number of its windows broken. Then other aeroplanes appeared and more bombs began to fall, and the German Staff, which included the Duke of Würtemberg, had to make their escape in motors in the direction of Ghent.

On the day following this raid, the Germans repaid the compliment. Above Furnes, where the King of the Belgians and President Poincaré were due to pay a visit, a German airman appeared ; but he was half an hour too soon. The party had not yet arrived, and his bombs, which fell wide of the mark, did little damage. The incident showed clearly, however, that a spy had been at work.

On another occasion, once more through the information of a spy, the Germans attempted a similar raid ; this was at Montdidier. Here for some days, in a hotel as is usually the case, the French had established headquarters. But the spy, though his information was accurate, evidently could not get it through in time. The French Staff had gone before the German

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aviator arrived. When he did come he was well primed with information. He aimed his bombs directly at the hotel in which the Staff had lodged. One of them—the nearest to its target—fell in the yard of a farmhouse which stood next the hotel; and the force of the bomb was so great that the building was practically destroyed. A miraculous escape was that of a baby, which had been left in a bedroom while the farmer's household was at work in the fields. It was found safe in its bed, though the furniture around it had been wrecked and the room was full of plaster and broken glass.

In this raid the airman dropped incendiary bombs. These are filled with petrol, and start a fire wherever they fall. One bomb fell on a grocer's shop, and the roof burst at once into flame. In the raids on Paris, too, incendiary bombs were used, and one of them set fire to a block of flats. Such missiles have, indeed, been used freely during the war.

A heavy responsibility, and one that will grow heavier, rests on those who safeguard the Commander-in-Chief or any distinguished guests, such as royalty, who may visit him. And this responsibility lies most heavily on the members of the Flying Corps, because it is they who, circling overhead, and viewing a wide space of air, can detect most readily any impending raid by hostile craft, and can also, which is more important, ward off the danger by assuming themselves a vigorous offensive. To our

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British pilots, when King George visited his troops at the front, fell the onerous task of protecting him by air. Wherever he went, at all times, there was one or more of these custodians high above him—wheeling and circling and watching the sky, and ready on the instant to rush at any marauder who might appear.

## XI

### AIR RAIDS ON COMMUNICATIONS

*"Railways are the arteries of modern armies. Vitality decreases when they are blocked, and terminates when they are permanently severed."*

"IMPERIAL STRATEGY," 1906.

ONE fact has been made clear during the war. It is this : that there are only a few destructive tasks in which, having regard to the machines and the missiles available, aeroplanes can be used with reasonable hope of success ; and in finding the airmen these tasks, and in employing them with promptitude, those in charge of the corps have shown their grasp of such possibilities as exist in aerial war to-day. Exposed to attack, and located easily from above, have been an enemy's railway communications. Also—and this is important from the aviator's point of view—damage may be done to a railway-line even by the accurate placing of a single bomb.

This, more than ever before, has been a war of railways. As it has been said, and said truly, a modern army is tied by one leg to a railway. In every movement made, in every advance planned, Headquarters must keep its eye on the

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railways. Vast masses of men must be moved, and moved often for long distances ; and it is usually important, also, that they should be moved quickly. Hence railways are of supreme value. It has been one of Germany's trump cards that she should possess, running across her country between east and west, such a system of railways that she has been able, as the need has arisen, to transfer troops from frontier to frontier with precision and speed.

"Let us," said in effect those who control the air services, "do what we can to harass our enemy by dropping bombs on the bridges and permanent ways that are most useful to him in his transport."

At the beginning of the war, apart from the fact that most of the machines available were needed for scouting or directing the fire of artillery, no bomb was obtainable that was sufficiently destructive. Attacks on railways had, of course, been discussed prior to the war, and bombs had been prepared and experiments made ; but these bombs were small. So in the first stage of the war, though there were opportunities, the dropping of bombs on railways proved a negligible factor.

As the campaign advanced, and lessons were learned, it was seen that, if a large biplane could be used, carrying one or two powerful bombs, damage and annoyance might be caused by attacks on the railways that lie behind the enemy's lines. Our French allies, quick as

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usual to grasp an opportunity, provided themselves with a large, metal-built biplane—a machine for weight-lifting and with a motor of 200 h.p., yet capable of flying at very fair speeds. An escadrille or section of these machines was assembled, and detailed solely for the making of destructive raids. The craft carried a pilot and a passenger, the latter being the bomb-dropper. Two types of missile were provided. One was a small yet powerful bomb, weighing about 20 lbs. Of these, when they were best suited for some specific raid, the machine would carry a dozen, in addition to its occupants and its load of fuel. But if a maximum of damage was to be done, if a railway-bridge or a train was to be attacked, the machine started out with only two bombs; and each of these weighed 130 lbs., and was charged with a special explosive, of which the French authorities were careful to guard the secret. While these new bombs were being tested, prior to their use at the front, one of them—when dropped from a machine in flight over a given mark—tore a hole in the ground 15 feet deep and 30 feet from side to side. So there was no need to question their power.

It is interesting to consider what the possession of such a weapon means. The aeroplane bomb requires no charge of gun-cotton to send it on its errand, as does the shell from artillery; or rather the aeroplane, as it flies, provides itself the motive power. And, when the aircraft reaches its

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objective, the force of gravity does its work, bringing down the bomb over its mark. An aeroplane that can discharge one of these high-power bombs is equivalent to a gun that can be fired above the enemy, for a distance, say, of forty or fifty miles, and used to bombard the communications that lie behind their lines. A Commander is given an instrument of destruction, and one extremely powerful, that has none of the limitations of range imposed upon a field-gun. The aeroplane will ascend with its bombs, carry them swiftly to some point, say fifty miles away, and drop them as directed on a railway-line or bridge; then it will return to its starting-point, gather up more projectiles, and repeat the attack. So the modern Commander has a weapon which will bombard an enemy, not at a range of from three to six miles but at a range of 100 or even 150 miles—at a range, indeed, which is limited only by the radius of action of the machine.

By using large bombs, and sending out several armed craft to co-operate with each other, the French obtained, more than once, surprising results in their air attacks on railways. In one instance, during that stage of the war which followed the deadlock on the Aisne, a French pilot in a single-seated machine, returning to Headquarters after a flight above the enemy's flank, observed two German trains which, bringing up stores and ammunition, were moving along a branch line. He alighted at his base and

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gave the news, and the commandant saw the chance for an aeroplane attack. He ordered out three of the bomb-dropping biplanes. They flew one behind the other towards the point where the German trains were passing slowly along a single line of metals. Disdaining a splutter of machine-gun and rifle-fire, directed against it by the soldiers travelling with the first train, the leading biplane dived swiftly, discharging a bomb at the engine. The range was short and the bomb fell true; the engine was hit. With a rent torn in its side, and the sound of a shattering report, it rolled sideways and crashed from the metals, dragging several trucks with it and spreading a scene of ruin all around. Meanwhile the second biplane, also flying low, had dropped its two bombs on the permanent way, which was uprooted and flung in all directions. The third bomb-dropper, flying towards the second train, missed with his first bomb, but placed the other in the middle of a row of trucks, with the result that the train was set on fire. In five minutes, appearing without warning out of the sky, these machines had brought about a complete disaster, both trains being damaged, one of them on fire, and the permanent way broken.

Frequently, if aeroplanes are available and ready to strike their blow, they have chances to harass the enemy on his line of communication. Between Lichtervelde and the German battle-front, for instance, just prior to a movement of



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German transport trains, a small squadron of French biplanes, making a flight late one evening, succeeded in tearing gaps in the railway in two places. The damage done was not serious ; it was possible, of course, to repair it ; but before these repairs were made the trains could not move, and this entailed a delay for the Germans that was annoying—and might in some cases prove critical. At Blangy, observing the movement of several German ammunition-trains, an aviator who carried bombs flew ahead of them and planed down low, placing his missiles with effect and tearing up the metals. And here, again, though it was not long before the line was relaid, still there was a delay ; and every hour counts in modern war.

A dramatic story is told of an air attack by night, which had a temporary railway-bridge as its objective. The incident took place while the French were retreating before the Germans, and Von Kluck was straining to reach Paris. The German pressure was heavy and continuous, their numbers apparently countless, and it was vital that the French, as they retreated, should do all in their power to check the enemy's advance. So bridges were destroyed and rail communications disorganized.

At one point, on a stretch of line that was strategically important, there lay a viaduct bridge across a river, and this the French blew up without compunction as soon as their rear-guards had crossed. The Germans, pressing

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swiftly on, passed from bank to bank on pontoons; and then their engineers were left to repair the broken bridge or build a temporary one, so that there should be a passage for ammunition and store trains. The bridge, the engineers found, was damaged beyond repair; so a staging had to be erected on one bank, and piles driven into the river-bed for the construction of a low-level plank bridge, the approach to which was made down a sloping section of the bank on a line of temporary rails. A large gang of engineers was set to the work, using pile-drivers and other gear, and they toiled by night as well as day, their staging lit by arc-lamps, which shed a glare over the water and the ruined bridge.

The work went ahead well, and soon the officer in charge sent a message to Headquarters, saying that by next morning all would be ready for the passage of the first train. But he was reckoning without the enemy. During the day a French aeroplane had passed above the bridge, and its observer had reported to Headquarters the repair work that was being done. It was no wish of the French Staff that this temporary bridge should be opened; yet the Germans were now holding the river-banks in strength, and a land raid was not feasible. So the Headquarters Staff consulted the Flying Corps, which had a camp some fifteen miles from the river-bank. Could a bomb attack be delivered on the bridge, so as to damage the

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temporary structure the Germans were erecting? Yes, replied the commandant of the air corps; but he explained that it had come to his knowledge that the banks above the bridge were occupied by German anti-aircraft guns; and, to hit such a mark as was offered by the construction work on the river, the attacking planes would need to fly so low that they would be in grave peril of being destroyed by gunfire. And, seeing that few aircraft were available in this area, he was chary of risking them on an undertaking that did not promise success.

"Why not," asked a member of the Staff, "attempt a raid by night? Your pilots know this country, having scouted over the river for several days; and they would be guided, when they came near the bridge, by the arc-lamps of the engineers. A night raid, with one or two lucky shots, and we might give them another two or three days' work."

When night came, the arc-lamps threw up their light, as usual, below the ruined bridge. The pile-driving machine, after emitting groans and pants and gusts of steam, had crept across the river, and was standing on a small siding under the bank; while along the temporary bridge itself—a substantial structure now, of which the engineer officer was proud—gangs of men were busy, under the glare of the arcs, clamping down the rails which would link the two banks. There were no signs of watchfulness, no suggestion of alarm. Between the

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enemy and himself, the officer knew, there were strongly entrenched lines of German troops. So he lit a cigar, having dined after a fashion at a village inn, and sat down on a baulk of timber at one end of his bridge. It was a dark night; beyond the range of the arcs blackness lay deep and impenetrable.

There was noise all round him—the clank and clang of rails, the ceaseless ring of hammers. He saw nothing and heard nothing until from the bank above his head, where a squad of soldiers was on guard, there came a chorus of shouts and a splutter of rifles. The officer sprang up; and, as he did so, he heard from a point to his left the “bang-bang-bang, bang-bang-bang” of one of the semi-automatic, high-angle guns. He began to stumble shorewards among the obstructions of the bridge; but he had not gone more than two or three paces when he turned and stood still. Something had caught his eye, a hundred feet or so down the river. Out of the blackness had leaped a vivid flash of light. It came from the bank, just near a clump of trees. For an instant, in the glare, he could see the trunks of the trees and the glint of the water. Then there was darkness and a loud report. He opened his mouth to shout an order. Being a man of perception, his brain had been quick to act. “A falling bomb,” he had told himself as the flash came. And, in another fraction of a second, he realized that his arc-lamps must be switched off, so as to

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baffle the aviators. He turned to shout to the engineer, who stood by the generating plant on the bank. But destruction came quicker than the spoken word. Following exactly the course of the river, and so low between the tree-lined banks that its wings seemed almost to touch the branches, came the dark shadow of the aeroplane, the noise of its motor deadened by the clamour on the bridge, and nothing revealing its presence save small flashes of fire that shot from the exhaust-pipes of the motor.

Over the bridge it swept, and two more bombs fell through the darkness. The first struck the water twenty paces short of its mark, exploding with a roar. The second fell true, striking the bridge almost at the instant the arc-lamps were switched off. There came a thunderous, metallic crash ; a glare that outrivalled for an instant the gleam of the arcs ; an uprising of timber and water and the bodies of men ; then darkness and a silence, in which could be heard, for the first time, the hum of the aircraft's motor as it sped away down the stream.

No trains, when dawn came, were passing across the temporary bridge. The centre section had gone completely—piles, staging, and metals. But already, undaunted in the light of the coming day, the human ants were toiling at their shattered work.

## XII

### THE PERIL FROM ABOVE

*"Men go down like ninepins; buildings collapse like a house of cards; guns are turned over as though by some unseen hand."*—A FRENCH PILOT,  
IN "THE DAILY MAIL."

FEW people, before this campaign, imagined that aeroplanes would be used for a deliberate attack on troops; the idea was considered part of the stock-in-trade of the novelist. Experts smiled when it was suggested that aircraft would drop bombs on bivouacs, or harass columns on the march. Yet to-day, in this war, we find that troops have been attacked from the air, and surprising results obtained. In France, as we have mentioned already, has been used an exceptionally destructive bomb; and it is a weapon that can be adapted specially for an attack on troops. Fitted with a fuse, it may be timed so as to explode when a few yards from the ground, and expend its energy outwards, in a horizontal direction, instead of using up most of its power in digging a hole in the ground—which was what aeroplane bombs did before these new types were evolved.

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The effect of this improved bomb is described by a French pilot. "It simply lays everything out flat," he says, "within the area of its explosion." The same aviator, in regard to the first attack he delivered while carrying the new bomb, says he crept down as low as 800 feet, in spite of a heavy rifle-fire, and dropped a bomb on a section of Germans who were bivouacking in a village. The shock of the bursting of the bomb, which sent a rush of air upward, made his machine rock; and when next he looked down he saw that at least thirty of the enemy lay dead and wounded.

To the Germans these bombs came as a surprise, and created much uneasiness. Missiles that had been dropped early in the war could be treated almost with derision, they were so ineffective; but here was something different; and the type of aeroplane which now carries these heavy bombs has become familiar to the German soldiers, who dread its approach and rush to shelter—if they have time to do so—when they see the ominous shape in the sky. That they have reason for their fear has been demonstrated. The pilot of one of these craft, seeing a detachment of cavalry moving along a lane between high banks, planed down swiftly over them, taking them partly by surprise, and dropped a bomb amongst them. The explosion of these bombs raises neither dust nor smoke; they burst merely with a flash. In this case, when the fuse did its work, men and horses were flung

## The Peril from Above

across the lane. Thirty cavalrymen were killed by this one bomb alone, and nearly fifty horses.

An attack from above, when so powerful a bomb can be used, becomes a factor definitely to be reckoned with. Apart from men killed and wounded—and this in itself represents a serious total—a column may be thrown into disorder by such an attack.

A point in the airman's favour, when he swoops over troops on the march, is that the fire directed against him is no more than spasmodic. Rifles there will be, of course, also one or two machine-guns ; but against these, as he is flying fast, and can dart away directly his bombs are dropped, he does not mind taking risks. Anti-aircraft guns, throwing shells, are what he has cause to dread. Of course it may happen that he will encounter one of these, mounted on a motor-car, and lurking in the rear of a column ; but this is a risk of war—a matter of luck ; and it is his business, if needs be, to take such risks.

At Autry, in a raid on German troops in bivouac, more than twenty men were killed by one bomb, and a dozen killed and wounded by another. A German cavalry officer, in a letter describing such an attack, says :—

“ The airman flew over us and dropped four bombs. Three of these were effective, with the result that we had twenty horses killed and ten wounded, and four men killed and eight wounded.”



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A point to be remembered, in such attacks, is that they are made on men who are in the fancied security of their camp—at some point, say, well behind the fighting line, where even the longest-range shell could not reach them. In an ordinary way, therefore, they would consider themselves free from anxiety, and able to enjoy with an easy mind their period of rest. But it is not so when there are aviators to be reckoned with ; this, indeed, is just their chance. A pilot notes a bivouac on the fringe of a wood, and steals towards it just above the tree-tops. His motor, of course, will be heard ; but he may not be seen until he is quite near. Then, darting low and trusting to his speed, he swoops to his mark. Half a dozen bombs, perhaps, he may scatter as he passes over the camp ; and in nine cases out of ten, despite the furious rifle-fire that will pursue him, he soars up again and is away. If the bivouac is that of cavalry the horses—as has happened in this war—may be stampeded in their lines, and their tired riders given hours of work in recovering them. A number of men, too, if the airman's aim is good, will have been killed or wounded. Nothing is worse for troops, or more trying for their nerves, than one of these air raids—coming often, as it does, at the end of a hard day's fighting. The soldiers feel their impotence ; they cannot rest in peace, even when miles from the enemy's guns.

An opportunity for the bomb-dropper, when information to guide him can be obtained, lies

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in an attack on the enemy's ammunition depôts. One well-placed bomb, alighting on such a mark, may do a vast amount of damage. During the fighting on the Aisne, gleaning details as to the position of a German depôt, three French pilots made a raid, and dropped a bomb which exploded a large reserve of rifle ammunition. There is the case, also, in which one of our British pilots dropped an extremely lucky bomb. This incident took place during the fighting in October. A pilot on a scouting flight observed below him a German ammunition convoy, which was passing along a narrow forest road, fringed by trees. Diving low, just so as to clear the tree-tops, he placed a bomb with absolute precision. It hit the leading wagon, then burst; and all the ammunition in the wagon—mainly field-gun and howitzer—exploded with a tremendous report. This explosion ignited the ammunition in the wagons which were following the one that had been struck. They, too, burst into flashes of flame; and, as the airman said afterwards, it was the finest firework display he had ever seen. Fourteen motor-lorries in all, with their contents, were destroyed by this one bomb; and the force of the explosion, which reduced the vehicles to twisted skeletons of metal, was so great that it split the trunks of neighbouring trees. Of the unfortunate wagon-drivers, as our official "Eye-witness" has told us, nothing remained save "some tattered boots and charred scraps of clothing."

Occasionally, during the war, an aviator has

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been able, by the timely dropping of a bomb, to help troops who are in action. One such instance, in which a pilot co-operated actively with a section of the French troops, occurred during the fighting at Sempigny, in the department of the Oise. Mr. T. F. Farman, describing in *The Field* what happened, wrote :—

“ A detachment of French troops, composed of one regiment of infantry, one squadron of hussars, and a section of cyclist mitrailleuses, was ordered to hold a position at all costs, but the enemy attacked it with overwhelming force, driving the French across a bridge without leaving them time to destroy it. The Germans, regardless of the heavy losses inflicted on them by mitrailleuses while crossing the bridge, pursued the French. In an irresistible rush, Uhlans and Prussian infantry came to hand-to-hand fighting with the French. . . . The main body of the foe was, however, still crossing the bridge, or still on the opposite bank of the river, when a French aeroplane came to the rescue. . . . Its pilot took accurate aim at the bridge, which was demolished by his bombs. The French, then assuming the offensive, drove that portion of the enemy's force that had crossed the bridge back into the river, where a great number of them were drowned.”

In most cases, though, an aviator drops his bombs at points which are removed from the actual fighting-line, it being the scheme to employ him for attacks which cannot be made by ordinary shell-fire.

## XIII

### THE "FLECHETTE": A RAIN OF ARROWS FROM THE SKY

*"Suddenly a soldier felt a pain in his foot. Bending down, he found that one of the small steel arrows had pierced his flesh. Another soldier had been hit in the leg; another in the neck; a third in both legs; a fourth on the cheek; while a fifth, struck in the temple, was killed on the spot."*

A GERMAN ARMY SURGEON.

THERE have been curiously primitive aspects to the war, despite its science. A French engineer officer has suggested, quite seriously, that the use of the catapult might be revived, so as to throw missiles into an enemy's trenches, when these are at point-blank range. It has been argued, too, with equal seriousness, that troops who try to rush a hostile position, under a heavy fire, should be given a light, toughened-steel shield, which they could hold before their bodies. Hand-grenades have been used freely in attacks on trenches; and bombs, too, at night, have been tossed upon the enemy; while in hand-to-hand fighting, among houses and in village streets, there have been struggles as fierce as any in the battles of the past.

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But the most curious fact, perhaps, is this: with the aeroplane, the world's most modern instrument of war, has been adopted the use of arrows—the weapon of antiquity. The idea comes from France, where there has been a quest for a weapon which should augment the use of bombs, and yet which would, like bombs, employ gravity to gain its striking force. It was suggested, in the first place, that an airman might take up with him a supply of bullets, dropping these on the heads of a foe. But this idea appeared clumsy and unscientific; it was thought some missile might be devised that would be more destructive. And so the "flechette" was evolved. Experiments were made first—this was about two years ago—with a heavy metal arrow, or dart. But only a few of these could be carried, so a smaller type was prepared: an arrow made of steel, about 7 inches long and a third of an inch in diameter, with one end pointed sharply and the other hollowed out on four sides, so that it is a cross-shape in section—this providing the effect, when passing through the air, of the feathering of an arrow.

These "flechettes" are packed in boxes of fifty, and carried by the aviator in his machine. The bottom of each box is made to open by the pulling of a string, whereupon the contents pour out in an irregular stream. What terrible weapons these arrows may prove, when released from any altitude, was shown in some tests in France, made prior to their use in war. A cow was selected

## The "Flechette"

as a victim, and placed in a field. Then an airman passed above the animal, at a height of about 2,000 feet, and released a shower of arrows. Several of them struck the cow, and went completely through its body, embedding themselves in the ground below. The animal was killed instantly. Even when dropped from a height of a few hundred feet, one of these arrows will kill a man.

The first use of "flechettes" in the war was at the beginning of September, when French airmen, armed with boxes of them, attacked German troops in bivouac. In one such attack, made on a squadron of cavalry, thirteen men were killed and injured, in addition to the loss of a couple of horses. In this case the airman passed above the bivouac at the height of 4,000 feet, and the attack came as a complete surprise, there being no warning of danger until the arrows descended and the stricken men and horses fell. When an aviator drops a bomb it may be seen falling, but the arrows are so small that the eye cannot follow them.

Frequently, after this, arrows were employed, and not only against troops in bivouac, but also against bodies of men when they were in the trenches or on the march. Against troops moving along roads in fairly close order, or against squadrons of cavalry, this new weapon has proved demoralizing. A man struck on the head is killed instantly. If he is hit on the shoulder, the arrow will penetrate deeply into his

## Aircraft in the Great War

body and inflict often a fatal wound ; or if one strikes him in the arm or leg he is incapacitated. Owing to the manner in which they fall from their boxes, and as a result also of the speed of the aeroplane, the arrows reach the ground one after the other in a stream. Therefore a pilot, flying from front to back of a column on the march, can rake it with his arrows, which will fall here and there along the lines of men.

There have been protests against the use of this weapon, on the ground of its inhumanity. The fact that the arrows fall silently and unseen gives them a sinister and treacherous aspect. Yet they represent, though in a new form, the modern science of war ; and in this science, which knows no sentiment, the most effective weapon is that which will kill most men. Modern artillery-fire is inhuman. The gunner aims his shell, coolly and deliberately, and with instruments of precision ; it screams through the air, say, for three miles, then bursts and kills a dozen men whom the gunner has never seen, and of whose actual existence he is unaware. He proceeds methodically to re-load, and continues to kill an unseen foe. There is no heat of conflict, no wrath to palliate the slaughter.

When sentiment intrudes itself on modern war, there are likely to be anomalies. A quick-firing gun is used, for instance, which throws a stream of 1-lb. explosive shells. This forms a deadly weapon, and its shells approach very nearly, in the results they achieve, to the explo-

## The "Flechette "

sive or expanding bullet, the use of which has been so strenuously condemned. Yet these quick-firers, which we call "pom-poms," were employed during the South African campaign, and have been used in this war as a form of anti-aircraft gun—one German biplane, at least, having been brought down by them. War, of course, is ghastly, whether you kill your foe with a submarine torpedo, blow him to pieces by long-range, high-explosive shells, or strike him down with a bomb or an arrow from the sky. The feeling that underlies the objection to the "flechette" is that it is an unsportsmanlike weapon; that the ordinary combatant has, in fact, no chance of avoiding it or of replying to it. But neither has he to the submarine, or to long-range artillery. When war became scientific, it ceased to be sportsmanlike. The "flechette" has proved effective, and is likely to prove more so; hence it will continue to be used—that is, of course, unless the belligerents themselves agree to abandon it, which seems hardly likely.



## XIV

### DESTRUCTIVE AIRCRAFT: A SUMMARY

*"For any purpose that tends to harass an enemy,  
aircraft may be used legitimately."*—"FLIGHT."

THE President of the United States, discussing aerial warfare with representatives of the Powers in conflict, made it clear that he disapproved, on behalf of his country, of bomb-dropping on unfortified cities which are occupied by non-combatants. This attitude is reasonable and humane; and so far as Great Britain is concerned, or her Allies, it is one with which they have shown themselves by their actions to be in accord. Circumstances may arise, naturally, which need special consideration. We have shown, for instance, how an air-raid may be aimed against Headquarters; and if Headquarters should happen to be established in some small and unprotected town, and bombs fall in any number, then ordinary civilians may be struck. Again, it may happen that, in attacking an airship shed, bombs may fall on an unfortified town. But generally speaking, and certainly

## Destructive Aircraft: A Summary

so far as British operations are concerned, it has been recognized that aircraft may be used, legitimately, only for such methods of attack as may have a genuine military significance. And under this heading may be grouped the attack on forts or the enemy's airships, when the latter are in their sheds or in flight, the damaging of railway lines and roads so as to hamper the passage of armies and convoys, the raiding of ammunition and supply depôts, and the harassing of troops in bivouac or on the march.

When this war is over, in view of the experience that has been gained, there will be need for a code of rules in aerial war. It is obvious already that certain forms of attack must be declared illegitimate. Take the case of a town, undefended and unfortified, yet possessing a railway junction that has military significance. Are raiding airmen justified in flying over this town and in dropping their bombs, merely with the idea of damaging the railway-station, and so hindering the passage of trains that may be passing through it to various points on the battle-front?

The whole problem, as a matter of fact, bristles with difficulties. In air-battles fought in the future—and it seems certain they will be fought—there may be grave danger for people who are on the earth below. Wrecked machines may fall to the ground, not in ones or twos but perhaps in large numbers—to say nothing of a rain of bombs and spent shells. Should an aerial

## Aircraft in the Great War

battle take place, say, over a largely populated area, such as the Midlands, many non-combatants might be killed by falling craft. Could it be made a rule of war that these air-fights should take place over the sea, or over uninhabited land? It might; but, even if such a rule was made, it would be broken probably. The Commander-in-Chief of an air-fleet, when manœuvring for position prior to a great conflict, would have but one aim in view; that would be to secure the tactical advantage over his enemy; and even should an air-battle begin, say, above the sea, the machines might move as they fought until they passed in over the land. Craft of the future will fly at immense speeds; air-battles, therefore, will be spread over a wide area of the sky.

Of course rules must be made, and drastic ones. But with a perfected aircraft, heavily armed and flying at great speed, and able to move at immense heights and shield itself among the clouds, grim weapons will be forged for an unscrupulous foe. Despite treaties or rules—unless human nature should change—the axiom that “might is right” may apply very forcibly to the air-wars of the future. Rules will be made, naturally, and in most cases honourably observed; but the nation will be wise which, while subscribing to the regulations, provides itself also with an air-fleet that is powerful enough to face all contingencies.

Already in this campaign, and with craft which

## Destructive Aircraft : A Summary

—when compared with machines of the future—are no larger than row-boats when set by the side of an ocean-liner, we have had a glimpse of what aerial war should mean. And, say in a hundred years' time, when another of these storm-clouds may threaten the world, there will be giant aircraft in existence, carrying large crews ; with engines developing many thousands of horse-power ; with a capacity to furl their wings, when in flight, and rush through the air at enormous speeds : armed with long-range guns, and with explosive and other bombs, and with instruments of precision for firing or releasing them. Imagine a fleet of such machines as these, passing through the air in a smooth and silent flight, and so rapidly that they could reach any part of the earth's surface, no matter how remote, in a journey of only a week's duration ; and then picture the effect of such air-fleets on war. To-day the war of the air is subsidiary to that of sea or land ; but in the future—perhaps in the next campaign—the war of earth or sea will be subservient to that of the air, its fate governed by the fighting in the clouds.

Naturally those on the earth, seeking for weapons of defence against an enemy in the sky, will not remain idle. There is a possibility, for instance, that, by a discharge into the atmosphere of powerful waves of electricity, forming an invisible though protective screen around a city threatened by attack, the magnetos of a hostile air-fleet might be short-circuited automatically, and their motors rendered inoperative.



**PART SIX**  
**DIRECTING ARTILLERY BY**  
**AEROPLANE**



# I

## THE ERA OF BALLOONS AND KITES

*"I saw guns dropping shell after shell into a certain area, and there wasn't a man within miles of it."*

A BRITISH ARMY PILOT.

NOTHING that can be said, no superlative that can be used, would over-estimate the services which have been rendered, during this war, by aeroplanes in their co-operation with artillery. They have proved so useful indeed, in range-finding for big guns, that if they had done nothing else, during the whole of the campaign, they would have more than justified their existence as an instrument of war. Experts told us, long before the war came, that the next struggle would resolve itself into a duel between artillery ; they were largely right. And in the successful handling of long-range guns, and in the placing of shells on an unseen foe, the aviators of the forces engaged have—for the first time in military history—provided observation work so valuable that, when on occasion they have been prevented from flying, there has been an immediate deterioration in the accuracy of fire.



## Aircraft in the Great War

In wars of the past, when cannon came first into use, there was no need for elaborate range-finding. The opposing batteries, each within sight of the other on the crest of some hill, trundled their balls across at point-blank range, and with more noise and smoke than actual carnage. Then, as larger pieces came to be employed, the range lengthened, and the task of the artillery officer began to grow more difficult. But still his perplexities were nothing, compared with what they are to-day. For many years, and in many campaigns, even if he could not see his opponent's guns, the officer who watched from a hill-top could trace the column of smoke that rose above them as they were fired. But then came the era of smokeless powder; and this, with the steady increase in range, made infinitely more difficult the problem of accurate shooting. With no trace of smoke to catch his eye, and with guns directed at him perhaps from several miles away, the artillery officer's task, even with the most powerful of field-glasses, and when installed at a point of vantage, becomes one of grave anxiety. An enemy's shells scream through the air towards him, but where is the exact point of their discharge? The officer, his glasses to his eyes, gazes across some undulating stretch of land, covered perhaps by gorse-bushes and little clumps of stunted trees. The background is one of neutral tints, with no clearly-marked skyline, and no sign of life upon it anywhere. Yet,

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whistling towards him with monotonous precision come the projectiles of the foe. Perhaps, if he is very fortunate, he may be looking just at the right place when there is the discharge of a gun ; and then the jet of flame from its muzzle will tell him what he wants to know. But such good fortune cannot be relied upon. As often as not, unless they have an observer from the air to tell them what they themselves cannot see, the gunners who are firing at, say, four positions known to be held by the foe, can locate the exact placing of only one.

In the days before aeroplanes, seeking for some instrument that might help them, artillery commanders made use of a captive balloon. Carefully organized balloon corps were attached to the armies in the field, and did excellent work. The balloons were brought up in wagons to a position behind the artillery, and inflated from a portable gas-plant. Then a small car was attached to the balloon and an observation officer took his place in it, carrying a field-telephone with him, by which he could communicate with the ground. When all was ready the balloon was sent up, being held captive by a wire cable. The balloon officer gained an excellent view-point, being several hundred feet or more above the ground. Sweeping the enemy's position with his glasses, he telephoned down to an officer who was stationed at the foot of the wire. The observer's first aim, naturally, was to locate the enemy's guns ; afterwards, when he had done

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this, he watched the bursting of the shells of his own battery, advising those below him should they be falling short or flying wide.

The enemy, as may be imagined, did not allow the balloonist to go unmolested. As soon as they saw him rise, they opened fire on him. But the balloon was an elusive and difficult mark, awkward to range on, still more difficult to hit. Its position, too, was frequently changed, and its altitude. And even though it should be hit by shot, it did not at once descend. The bullets passed through it, and a certain percentage of gas escaped ; but it required many such punctures to bring a balloon to earth. There was, of course, the chance of scoring a direct hit with a shell upon the envelope of the balloon, and this might tear it badly ; or some marksman might actually hit the observer with a bullet ; but both contingencies were remote. The Boers, during the South African War, learned to dread the rising of one of the British balloons, because it was followed usually by a far greater accuracy of shell-fire. They told off picked marksmen to do nothing but shoot at the balloons ; but these men, though they were magnificent shots, and sent bullet after bullet through the envelope of the balloon, found it was practically impossible to hit the officer in the car, and so their fire was almost valueless. The observation officer's position, all the same, was scarcely pleasant. Shells shrieked past him and there was a constant whine of bullets, and he was unable in any way to

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respond to the enemy's fire. All he could do was to derive what comfort was possible from the knowledge that, according to the law of average, the chances of his being hit were exceedingly small.

Such balloon control had limitations. The balloon could be sent up only from some spot that was well behind the position held by the guns. To put one up nearer the enemy, within easy range, would have been to court destruction. The observation officer was, therefore, at a considerable distance from the guns he had to watch, and this lessened frequently the value of his reports—particularly when the air was misty. Wind, too, was apt to prove troublesome. When it was gusty the balloon rolled and pitched at the end of its cable, making things unpleasant for the officer in the car, and hampering him seriously in his work. Should a really strong wind spring up while a balloon was aloft, there was the risk that it would break its cable and drift away ; or, even if it did not do this, its swingings became so erratic that observation was impossible, and it had to be hauled down. On anything like a windy day, indeed, the use of balloons was vetoed, and this was a serious drawback. It meant in many cases that, just when they were needed most urgently, balloons were unable to ascend.

This difficulty, which was inherent and could not be overcome, led to a search for some apparatus that would ascend in a wind ; and,

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aeroplanes being craft of the future, dreamed of only by enthusiasts, the choice fell upon a type of man-lifting kite. With an apparatus of this kind, it may be remembered, the late Mr. S. F. Cody made his advent into the world of aviation. His kites were on the box principle, with strong fabric stretched upon a bamboo framework. The system was to send up several of these kites in a team, one above another, and all pulling on a single cable. Then a small basket was attached to the cable, being fixed so that it would run upon a flanged wheel, and in it the observation officer took his place. Another kite was now flown, and attached directly to the basket containing the observer; and it was the pull of this kite which drew the basket, with its occupant, up the wire. He had a brake with which, when a sufficient altitude was reached, he could check his progress and hang motionless on the wire; and, when he wanted to descend, he could tilt the kite above him so that its lifting-power was reduced, and it allowed the basket to glide down the wire. The Cody kites, and others on different lines, have proved useful when balloons could not ascend. The higher the wind, up to a reasonable point, the better and more steadily the kites would fly. And the observation officer, when necessary, could ascend in his basket to a considerable height—an altitude of 3,000 feet having more than once been attained. Another advantage with the kites was that they offered a small mark for gunfire.

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Sometimes, indeed, when the weather was cloudy, with a dull sky, and the kites were at a height of several thousand feet, it was difficult to see them at all, much less hit them with a shell or bullet.

But there was a drawback with kites, as with balloons, from the point of view of observation. The officer in his basket was, necessarily, a long way from the battery or position he was watching ; he could obtain only a slanting view across the enemy's territory ; and this, if trees or ridges intervened, meant often that he could not see clearly all he wished to see. The ideal, of course, was some position almost directly above the enemy ; but such a view-point, until the advent of the aeroplane, was unattainable.

Apart from the use of balloons or kites to direct the fire of big guns, a system was gradually built up of land observation. The field-telephone helped materially in this regard, enabling officers to take up a position some distance from their guns, and still keep in constant touch with them. Prior to the use of the telephone, when orders for a battery were sent by flag signal, or a relay of messengers, the controlling officer was obliged to remain fairly near his guns ; and this, of course, limited his choice of a view-point. But with a telephone-wire as a link he could seat himself on a hill, or amid the branches of a tree, a mile or more away from his guns, and still direct their fire

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while he watched that of the enemy. In this war, through the use of the telephone, quaint incidents have been recorded. There is the story, for instance, of the German officers who, with their telephone and a week's provisions, concealed themselves in a haystack right inside the British lines, and were describing our positions to the German gunners, when some small accident revealed to us their hiding-place.

Telescopic ladders, run up behind the shelter of a tree or house, are used for artillery observation. The Germans also employ a type of periscope, rather like that of a submarine, which can be raised on a mast behind the shelter of a tree. The observation officer at the foot of the mast, looking through an eye-piece, obtains a view over a section of the country that lies ahead. But all such methods, when long-range guns are used, and the nature of the country offers a screen for the batteries engaged, leave much to be desired. To an artillery officer on a hill, just behind the fighting-line, may come, for instance, the message that, on certain of the trenches below him, the enemy has been concentrating a rapid and galling fire. Cannot he stop this? Cannot he silence the hostile guns? He wishes very much that he could; but even from his position in a wooden seat or shelter, up among the branches of the tallest tree, he cannot detect the hiding-place of the enemy's battery. They must be somewhere along an

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opposite ridge—but where? Again and again he sweeps it with his glasses; and in the meantime the battery below him, making up in ardour what it lacks in information, searches with its shells the whole of the ridge.



## II

### ADVENT OF AEROPLANE CONTROL

*"Ah! There's that wretched bird that haunts us!"*

AN ARTILLERY OFFICER.

WHEN the aeroplane became a practicable craft, able to ascend quickly to high altitudes, and fly in winds as well as in calms, its potentiality was realized as an adjunct to artillery. It was realized that it would give an observation officer a view-point he could not obtain in any other way—not a slanting, distant view, such as had been possible with balloons and kites, but a view directly down upon the enemy's lines; one, furthermore, that was not stationary in the air, but could be moved rapidly from point to point.

Tests were made, therefore, and with success. In manœuvres, and at aviation training-grounds, co-operation with artillery became one of the features of a military pilot's work. And then, almost too soon, there was the outbreak of war—too soon, that is to say, from the point of view of the aircraft available. It was impossible, with the small air fleets that existed when hostilities began, to find machines for all the tasks that

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awaited them. Scouting was recognized as the primary work ; upon this the air corps had to concentrate ; and what machines could be spared from this task were devoted to artillery control ; but they were not sufficient.

Germany, in the first stage of the war, profited most by the use of aeroplanes with artillery ; and this was because, in co-operation with her troops in Belgium and in the North of France, she had for a time more aircraft than the Allies. In the first rush of the Germans notably, when Von Kluck assailed the British and the left wing of the French, the air control of the German artillery was surprisingly well organized. And it proved all the more striking because this co-operation was so new. Here, for the first time in war, the theories of peace manœuvres were put to the test ; and, as the British and French found to their cost, in that furious onslaught made on them after the fall of Namur, airmen were able to increase, almost beyond belief, the accuracy of the enemy's fire. The Germans, with an immense force of artillery at their command, rained shrapnel on our trenches prior to each of their attacks ; and it was here that their aeroplanes did such vital service. Shrapnel-fire against trenches, before the use of aircraft, often proved wasteful. A shrapnel-shell, to do its work effectually, must burst at precisely the right moment—just before it reaches the trench it is aimed at, and at the correct height above it, so that its rain of bullets, sweeping

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forward and downward and spreading like a fan, may strike at the infantry in their burrows from an angle at which they are least protected. To gain this result, gunners must know with perfect accuracy the range of the trench against which they are firing. But such detailed information, without aeroplane reconnaissance, is very difficult to obtain. With the aid of an air-scout, however, and one skilled in his work, the use of shrapnel against trenches can be made devastating. The pilot ascends, passes above the enemy, and notes the exact position of the trenches to be shelled, even when these are so well concealed that they are invisible to any observer looking towards them from the ground. When he sees, on glancing down, that his machine is just above the trenches, the airman makes a signal that can be noted, and understood, by the officers of the battery with which he is co-operating. They, of course, have been watching the aeroplane through their glasses; and so soon as they receive the aviator's signal they direct their fire accordingly. He, circling and watching the bursting of the shells, signals again if necessary to correct errors in the aim.

The German aircraft, acting in conjunction with their artillery in the fighting around Mons, obtained results that were astonishing. Our own small air corps, at this early stage of the campaign, was scarcely in a position to show what it could do, and the French machines were distributed along a wide front.

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So the German craft, in this opening phase, outnumbered those of the Allies on the Western front ; and they were, in addition, concentrated for a time upon artillery control.

The effect of their work, so far as the Allies were concerned, and particularly in regard to the British at Mons, was disconcerting in the extreme. Trenches were dug—deep, workman-like trenches—in just such positions as they ought to occupy, and with nothing in their appearance to catch a hostile gunner's eye. But then, just before the artillery fire began, there came a hum from the air ; and the soldiers, installed snugly in their trenches and looking upward, saw at a height above them the bird-like shape of one of the German monoplanes. It wheeled to and fro, little method, apparently, in its manœuvring. Then it dropped a bomb, which left a trail of black smoke. After this, sweeping away in a wide circle, the machine vanished for a time. Whereupon, for ten minutes perhaps, there was peace ; but it was the calm before the storm. Suddenly, from their position behind some concealing ridge, the German guns began to fire ; and the shells that came whistling towards the trenches were the result of no tentative, random aim. The German gunners, though they were operating perhaps several miles away, and could obtain no view at all of the target at which their guns were aimed, were able—thanks to their aeroplanes—to work out the range with a precision that had

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been impossible hitherto. The shells curved over and downward towards the trenches, bursting above them each time with accuracy. Such gunfire had never been seen before ; it was staggering. The lash of the falling bullets was continuous ; the clamour of the bursting shells, which rushed over the British trenches by the hundred, made a din like that of some vast boilermaker's shop. Never before have troops had to undergo such an ordeal, or one so unexpected. And yet, as we know, our men remained unshaken. There was none of the demoralization, as a result of this dreadful fire, that the Germans had reckoned to produce ; and when they charged in huge numbers, as they did after their artillery had done its work, they found undaunted men awaiting them, and were mown down themselves by a cool and accurate fire.

Nor did the German airmen, for long, have things their own way. Our pilots, and those of the French, were quickly at work ; and many of the German aviators, when they approached the positions of the Allies, found that hostile aeroplanes were ready to rise and meet them and that, instead of devoting themselves to the observation of trenches, they were compelled either to fight in the air or retreat towards their own lines. There were guns to be reckoned with also—the special anti-aircraft guns ; and these, handled daily with a greater skill, were, of course, a growing menace. The German air-

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craft, in fact, like the German Army, was at its maximum efficiency in the earliest phase of the war ; while ours, and those of our Allies, did not at once attain their fullest power. The German aviators did some of their best work during the rush on Paris. After this, owing to the steadily increasing activity of our aeroplanes, and those of the French, and owing also to the weight and growing accuracy of the gun-fire with which it was assailed, the German air corps seemed to lose—at any rate for a time—its early initiative. Contributing to this result no doubt was the fact that, putting her best pilots at once into the field, Germany lost heavily in efficiency when these men were shot down, and either captured or killed. It is not difficult, in time of war, to provide new aeroplanes in the place of those which are destroyed. The real difficulty is to find the expert pilots who will navigate them—such men, for example, as have been trained specially to co-operate with artillery in the field.

It was certainly unfortunate for the Germans that, as their air control for artillery grew less effective, that of the Allies should have begun to reach its full efficiency. As soon, indeed, as the tide of war commenced to flow away from Paris, and the Germans retreated towards the Aisne, the vigour of the Allies' air work began to tell its tale. So far as air fighting is concerned, we can deal with this most conveniently in Part Seven ; but in the task of artillery control, thanks to the excellence of our machines

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and the courage of our pilots, we were able to repay the Germans in their own coin, and silence their artillery in the same way that they, in the first flush of their success, had silenced ours.

It is essential, in the co-operation of an aircraft with its artillery, that there should be a rapid means of signalling between the two. According to one system used by the Germans, in the first stage of the war, the aeroplane dropped a smoke-bomb when it found the position of the target ; and the exact range from the guns to this target was ascertained by an officer who used a telemeter, or some other type of range-finder, which was trained constantly on the aeroplane ; so that, at the moment the bomb was dropped by the pilot, the distance to the mark below could instantly be obtained.

Another method, used also by the Germans, was more elaborate. The airman flew to the position that was to be marked, and then made a figure of eight in the air over it, steering so that, when he was at the centre of this figure, his craft was as nearly as possible just above the target. Then, so as to make the mark still clearer to his gunners, he dropped a white fuse and circled away—keeping an eye earthward all the time, so as to be able to note where the shells of his artillery were falling. If he saw they were dropping too much to the right he threw out another fuse—this time a yellow one ; or, should they be bursting to the left, a blue fuse.

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In peace experiments, made between British aeroplanes and their artillery, a method employed had been for the aviator, after he had carried out his observation, to return to a point in the neighbourhood of the guns, and there either alight and present his report, or drop a written message in a bag, to which was attached a brightly coloured flag, making it visible as it fell. But it was discovered, in actual war, that this system involved a waste of time, and it was abandoned. Wireless telegraphy, among the methods substituted, played an important part, signals being arranged which, from a machine in flight, could be sent with accuracy and rapidity to a receiving station near the guns. But the use of this system was limited, particularly in the early stages of the war, by the fact that few machines were equipped with wireless.

There must be modifications, of course, to all such systems, governed by the necessities of the moment and the apparatus to hand. But the aim is always to save time, and make the communication between aeroplane and guns as close and frequent as possible. Sometimes it has been found helpful to make a rough sketch of the position of the enemy's batteries, the pilot taking up with him an observer who, after he has made a rough sketch in pencil, encloses it in a small tube with a flag attached, and throws it to the ground near the guns.



### III

## THE CONCEALING OF GUNS

*"Our warfare seems to be a daily round of digging holes and hiding from aeroplanes."*

AN ARTILLERY OFFICER.

A RESULT of aerial fire-control, and in some cases an amusing one, is that vast ingenuity is now displayed in the shielding of batteries from an observer—the idea being of course that, as the airman looks down, he should see nothing, say behind the curve of a ridge or on the fringe of a wood, that may attract his attention. Guns have, whenever possible, been placed in clearings on the fringes of woods, with nothing but their muzzles projecting. And, when such a natural shield has been unavailable, artillerymen have been ordered to bring boughs of trees and bushes, and build over their guns a dummy screen. Some success has been obtained in such concealment, though it is not easy to deceive a skilled observer; and it has happened frequently that, though they might wish to rig up an artificial shield, the gunners have had no time to do so. If circumstances are favourable,

## The Concealing of Guns

though, and there is time to prepare some such structure, it is possible to hide very completely the position of a few guns—as the following statement, made by one of our artillery officers, goes to prove. He says :—

“ We had two guns in position for many days, which were absolutely hidden in a very queer and cunning way, and no aeroplane saw them. They knew whereabouts we were and searched everywhere. They fired over a thousand rounds into a village on our right, and one in front. They got several rounds near our guns, and others over them ; but luckily they changed their minds, and went back to the empty village.”

When they have had time on their hands, and there have been ingenious minds amongst them, artillerymen have played jokes at the expense of the air-scouts. The heroes of one such exploit were the gunners of a French battery ; and the incident took place during a lull in the siege warfare of the Aisne. This battery had been annoyed by the attentions of a German monoplane, which passed above them periodically in its search for targets. So the gunners, obtaining a few hours of leisure, cut down a tree and stripped the branches from its trunk. Then they cut the trunk to the same length as one of their guns, and dragged it to a clearing near a hill-top. Here they fixed up the tree-trunk on a cart, and arranged it so that it would bear the appearance—at any rate from a height of several

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thousand feet—of one of the big French field-guns the Germans have learned to dread. Then, in realistic attitudes, they grouped themselves round the dummy gun, and waited till the monoplane should make its appearance.

Before long it came droning overhead, turning here and there like a hawk seeking its prey. Whereupon one of the gunners, just at the right moment, lighted some straw that had been pushed into the hollow at the end of the tree-trunk. The result was a flash and puff, just like that from the discharge of a gun. The German aviator saw this, and swung towards the spot; whereupon the manœuvre was repeated, and he was tricked completely. Dropping a bomb to mark the position, he sped back towards his own lines; while the French gunners, knowing that soon it would be unhealthy to be where they were standing then, hastened to a point of vantage and awaited events. They were not long in suspense. There was a distant boom; then a shell came whining through the air, falling in the trees near the clearing, and exploding with its metallic crash. After this, to the delight of the Frenchmen, German gunners concentrated their fire on this clearing, in which there stood nothing but the dummy gun, and wasted hundreds of shells before their fire was drawn by some other target.

It is possible sometimes, granted there is time for such a stratagem, to deceive an airman as to the location of trenches. A trick played

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more than once, and with success, is for infantry to make a line of dummy trenches, quickly and easily dug, some distance away from those they intend to occupy. Then, when a hostile aeroplane appears, the men scramble into the dummy trenches and wait till they are seen by the pilot above. He drops his bomb to mark their position, and soars away on some other quest; whereupon the infantry scuttle from their false entrenchments, which are shallow furrows in the ground and little more, and retire to the line of trenches which are meant for actual work. Soon after they have gone the enemy's guns will come into play, expending shell after shell on these dummy trenches, which have not a man within hundreds of yards of them. But such tricks, in the exigencies of war, can be played only once in a while; they form no effective counter-move. An aeroplane controlling artillery, if it is to be harassed definitely in its work, must be fought in the air and shot at from the ground.

## IV

### AERIAL RANGE-FINDERS AT WORK

*"Better is the sight of the eyes than the wandering of the desire."*—ECCLESIASTES.

WHEN conditions are favourable, when aeroplane and artillery are working well together, an amazing accuracy of fire is sometimes possible. There is, for example, an incident which occurred at Furnes, during the time Belgian troops were there. In the garden of a small cottage, which stood by itself near a road, a party of officers were holding a consultation, several motor-cars waiting for them near the garden-gate. Presently, flying high, a German aeroplane passed above. The airman must have seen the stir and movement by the cottage, though he gave no sign of having done so. After a few wide circlings, he flew off the way he had come. Nothing happened for a while, the Belgian officers being busy with their maps. Then suddenly there sounded a faint whistle, which rose quickly to a shriek, and spoke of the rush through the air of a heavy shell. Fired from a weapon several miles distant, and whose gunners had no means

## Aerial Range-Finders at Work

whatever of viewing the target at which they aimed, the shell flew towards this solitary cottage with an accuracy that appeared supernatural, and burst actually in a corner of the little garden—throwing up earth in a fountain, and emitting a huge cloud of black smoke. Away back among their guns, invisible behind some copse or hillock, the German artillery officers had, after receiving the report of their airman, calculated the range of this cottage to within twenty yards ! But for that small error the Belgians were duly thankful ; it was sufficient to save their lives.

Motor-cars containing Staff officers and other distinguished people, as they pass from point to point behind the firing line, are seen occasionally by a range-finding airman, who drops a smoke-bomb over them ; and this, as it bursts, is the forerunner of a rain of shells. Naturally the driver of the car, having seen the aeroplane and the fall of the bomb, seeks a less dangerous neighbourhood as quickly as he can. Among stories told in this regard is one concerning Lord Murray of Elibank. He was near Soissons, a little way behind the trenches, when a German pilot marked his car—thinking it might contain a General, or perhaps even the Commander-in-Chief. Then there came the usual hail of shells, and the car—before it drew out of the danger-zone—had to run the gauntlet for several minutes. General Joffre, it is said, had an escape one day, a shell falling in the road within a few yards of his car.

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One of the best incidents of the war, as showing the power of a range-finding aeroplane, occurred during an exchange of shells between a French and German battery. The French guns, cleverly hidden, were making admirable practice against the German position. Shells, perfectly timed and placed, burst ceaselessly above the enemy ; while the German gunners who were replying, though serving their weapons smartly and with courage, had failed to locate the exact position of the French, and were at such a disadvantage that their shells did little harm. The French fire, rapid and pitilessly accurate, became intolerable ; the German artillery officers saw that unless something was done, and done without delay, their guns would be silenced and they might have to abandon them. So an urgent message was sent to the aircraft base, established a mile or so to the rear ; and in a few minutes an aeroplane appeared above the German lines. Out it swept towards the French position ; and near it as it flew, but mainly below and just behind it, appeared fleecy white clouds of smoke which denoted the bursting of shrapnel shells.

Swiftly it moved, and was soon above the French. Then it began to make short turns—now right, now left—seeking diligently for the guns which were so harassing its artillery. Almost directly above the hidden battery, in one of his swerves, the airman steered ; and the French officers, lying prone among bushes, looked up

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at him with imprecations, and prayed he might not see their hiding-place. Whether they had been observed or not they could not tell; the aviator made no sign, and continued his flight until, with a final sweep, he reached his own lines again and was seen to be descending.

After this, for a time, there was no interruption or change in the progress of the duel. The French guns raked their foe; and the Germans, though maintaining a steady fire, were still sending shells wide of the mark. The French officers heaved sighs of relief; it seemed clear the aviator had not detected them. But they congratulated themselves too soon. Suddenly, above the monotonous thunder of the distant guns, there sounded a new and an arresting note—a deeper, louder, and more reverberating boom. Then came the ominous scream of a large projectile; and a second or so later, right above the hidden position of the French battery, burst with tremendous force a high-explosive shell—one of the largest fired by the German guns. It became clear to the Frenchmen, now, why there had been a delay after the German pilot had made his flight. He had not risked the shrapnel-fire for nothing. Though he had been flying high, and the French guns had been well concealed, he had been able none the less to detect them, and had flown back with his intelligence, conveying it to the German officers by word of mouth, and indicating on their maps the position of the French guns. At this, overjoyed by such accurate information,



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and wishing to celebrate the occasion in a suitable way, the Germans had called up from a reserve position one of the largest of their guns ; and it was the bringing forward of this gun which had accounted for the delay between the flight of the aeroplane and the falling of the shell.

A sudden and accurate concentration of fire, such as is possible by the use of aeroplanes with artillery, may prove disastrous in its effect—particularly should it come as a surprise. If a battery is caught in an exposed position, and is raked unexpectedly by hostile guns, it may be almost blotted out of existence before there is a chance for it to limber up and retreat. Modern shell-fire, when focused on some given spot, is so terrible that men and horses are mown to the ground. A tragic story, which illustrates this, is told in France in regard to those artillery duels which were fought ceaselessly along the Aisne ; and we re-tell it here, with such emphasis as technical knowledge may suggest, and the drama of the tale itself will justify.

A line of German guns, all more or less concealed, were exchanging shells with a French battery, extended cleverly along a wooded ridge. Just to the right of the German position, and offering a capital position for some of their guns, was a low hill. Officers had crept to the top of it, and had returned with the report that, could guns be installed there, it might be possible

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to silence a section of the French battery on the ridge, which would lie exposed to a fire from this vantage-point. But the difficulty for the Germans was this: there would be no cover for the guns as they moved up towards the hill, or when they were ascending the side of it; the hill, indeed, stood out bare from the surrounding country, with no tree or shelter near. It was possible, of course, to send guns well to the rear, where they would be out of sight, and then bring them back again behind the hill, so that its slope lay between them and the French. By doing this, guns might come into position just behind the crest of the hill, without the French gunners having observed their approach. But this would not suffice; it was not enough merely to escape the eyes of the French officers on the distant ridge. There was another factor to reckon with. Here and there overhead, while the bombardment was in progress, flew French aeroplanes; and the hill to the German right, being of tactical advantage, was under observation. It was useless to hope to reach the hilltop from the rear—so long, at any rate, as there were these prying eyes in the sky. The airmen, looking down not only on the top of the hill, but also behind it, would see the guns coming into position, and signal the fact to the French; and as the latter had already taken the range of this hill, and could train guns quickly on it, the fire they would open would be intolerable. The sole chance of

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success, indeed, lay in getting guns to the hill-top unseen, and in raking the French batteries with an accurate fire, before they had time to make an effective rejoinder. The German officers, weighing pros and cons, were forced to leave the hill alone. There it lay, tempting, on their right; but so long as the aeroplanes were aloft it might prove a death-trap, and not a vantage-point, for their guns.

As the day advanced, and fire was maintained with brief intervals, a wind began to rise. It was nothing at first—a mere succession of gusts; but soon the sky grew overcast, and it blew in earnest. There were heavy, driving squalls, which bent the tree-tops; and one by one, battling down to their headquarters, the aeroplanes vanished from the sky. Several of the Frenchmen, however, pilots highly skilled, refused for a long time to give up their struggle against the wind. Flying high, and with powerful machines, they swung and dived and plunged, dropping many feet one moment, only to be thrown upward the next as though on the crest of a wave. But the wind continued steadily to rise; and the German artillery officers, watching the sky keenly through their glasses, saw the last of these air champions turn at length, and swirl like a wind-blown leaf towards the French lines.

Now, surely, there lay a chance; the German officers came together in a quick and eager group. Inquisitive eyes being removed from

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above, it became feasible to use the hill. A message was sent by motor to the rear, and a battery pushed forward. Meanwhile, moving across through lanes and hedges to the hill, several of the German officers took up their position on it, and kept the enemy under a constant scrutiny. More particularly they searched the sky, now studded with low, fast-moving clouds. These made observation difficult, but none the less the Germans felt satisfied ; there was nothing to be seen aloft, and they did not believe there was an aeroplane that could be flown in such a wind.

The battery came thundering up a lane, then halted at the foot of the hill to await instructions. Whereupon the officers on the summit, sweeping sky and land in a final glance, sent down the message that it was to ascend the hill-side. A rough track wound its way up the slope, and along this came the guns, the horses straining, slipping, and panting at their work. Officers walked down to meet the battery and guide it to the firing-point chosen ; but they left one of their number on the hill-top, lying snugly among some bushes, his glasses constantly to his eyes.

Here and there he looked, scouring the distant ridge and the cloudy sky that lay above ; but there was nothing to be seen. So he shut his eyes for a moment, to rest them from the strain, and lay listening to the advance of the battery behind him. Up it came full-tilt, drivers busy with their whips, officers calling their orders as

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they pointed to the spot, just behind the crest of the hill and on a gentle slope, where the guns were to be lined in position.

Again the officer on the hill-top raised his glasses. His head ached a little, and he was tired; but he was a conscientious man. So he swept his gaze from left to right again, expecting to see nothing, yet concentrating his faculties on the task. Here and there, along the opposite ridge, he could see a spit of flame; and among the exposed French guns that stood nearest, and which would soon, he hoped, be decimated by the fire of the battery behind him, he could see every now and then the tiny, busy figures of the French artillerymen. One by one, just to his rear, and with reverberations which shook the earth on which he lay, the German guns came trundling to their stations and were unlimbered. He expected, in a moment or so, to hear their first discharge. How his eyes ached! How he would like to drop his head and sink to sleep! Even the roar of the guns, he thought, would not wake him. But the call of duty was stern, and again his glasses roved. Then, in a final sweep before resting his tired eyes, he scanned the higher stretch of sky that lay over the valley between him and the French. He saw a bank of cloud passing almost above him, with a rift towards its centre. He noted, idly, the clear-cut edges of this cloud, and was about to drop his glasses and rest again the muscles of his neck, when

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something caught his eye—an insignificant speck, passing slowly from the cloud into the rift of open sky. Without suspicion, without any show of interest, he turned his glasses for an instant on this elusive speck. It seemed no larger than a bird ; unless one had been looking at just this section of the sky it would have been impossible to detect it. The officer eyed it casually ; then riveted his attention, holding his breath ; then altered slightly the focus of his glasses, so as to get the clearest possible view. For a second or so he was uncertain ; then the light strengthened a little, through a movement of the clouds, and in a flash all doubt had gone. It was an aeroplane, flying high, straight into the teeth of the wind ; and the officer knew, from its wing-form and type, that it could be no German craft. Dazed for a moment, he stared upward at this lonely speck. It was so remote, so small against the sky, that it seemed scarcely possible it should be a harbinger of evil—a bird of ill-omen that might presage a rain of death. But suddenly, as he gazed, the watcher was seized by an impulse of frantic energy. This man up aloft, this unseen air-scout, might have been watching them for some time. Obviously he had not braved such a wind for nothing. Perhaps he was watching the hill now ; perhaps he had signalled already to his guns the fact that the German battery was creeping to its position ; and if he had done this—and as the Frenchmen had already the range—at any moment there might

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come a hail of shell, which would sweep the Germans from their guns before they had time to use them.

The officer sprang up with a shout, and turned towards the busy scene below. The last of the guns was moving to its post. Those already in position had been swung to face in the right direction, and the gunners were busy, preparing them for fire. Their movements hidden by the hill-top from any hostile eye on land, the artillerymen were unconscious of this other and unseen eye, noting their movements pitilessly from a height of 8,000 feet.

The officers who stood near the guns, engrossed by their preparations, did not hear their companion's cry from above. He shouted again without effect, then turned to run down the slope. But even as he did so—tearing its way venomously through the wind with a high note and then a low—came the first of the French shells. It was a little short of its mark, perhaps fifty or sixty yards. It burst, indeed, on the hill-top instead of over the crest. The officer who had begun to run must have heard the wail of its approach; but that was the last thing he did hear. The shell pitched within five yards of him, and when the smoke cloud trailed away in the wind he was gone, stricken as he ran, his body shattered and torn asunder.

The men near the guns looked up the hill; for an instant they stood silent in their places, like a group on a stage; then there were hoarse shouts

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and cries, with the high-pitched call of orders and the galloping of horses from their positions in the rear. For a moment or so there was this medley ; then the shell storm broke. It came like an avalanche—ceaseless, pitiless, devastating. The French guns, with a succession of roars that blended into one harsh and continuous note, concentrated their fire on this one spot. The shells rushed through the air and burst so rapidly the eye could not follow them. Here and there, to and fro, everywhere it seemed, appeared the puffs and smoke-clouds of their discharge. The German battery, with its horses, men, and guns, seemed to vanish under this hail of death ; an acrid pall hung over them, added to constantly as the shells fell and burst. Then at last there came a lull, and the wind blew away the smoke round the side of the hill.

Here and there a man stirred ; here and there a horse struggled ; but that was all. For the most part the scene was quiet and silent. Movement had gone ; sound had gone ; and there was little to be seen, mercifully, save here an uptilted gun, and there—as though stricken as they stood by some awful breath—a twisted heap of human forms.



## V

### GUNS, FOG, AND HOSTILE CRAFT

*"We could see the thing stagger; then it dropped like a stone. Good-bye, Mr. Flying Man! That was the end of him."*

A BRITISH SOLDIER, IN "THE DAILY MAIL."

THREE factors may prevent the use of aeroplanes with artillery. One is bad weather; the second the fire from land-guns; and, for a third, the attacks that may be made on them by hostile aircraft. Wind is no deterrent—not, at least, until it rises to a gale; but a heavy mist, such as may occur during the winter months, places a screen that is impenetrable between the airman and the ground; and in such conditions, till a breeze springs up and drives a mist away, the artillery may be deprived completely of its range-finder in the air.

Should a battle be in progress while the atmosphere is misty, and aircraft become inoperative, their failure to help the artillery, and particularly the long-range guns, may have a serious influence on the accuracy of fire. During what has been called the Battle of Flanders, which was made up of a series of

## Guns, Fog, and Hostile Craft

engagements, each a battle in itself, there was an example of the dependence of artillery on the aeroplane. Our Allies, the French, were the troops concerned, and a correspondent of *The Morning Post*, in a dispatch dated November 12th, placed on record concisely the point that is of interest here. He wrote—

“ It was a distinct point in favour of the French that the weather during this battle had become misty, with fog hanging up aloft for a considerable part of the day. This prevented the use of aeroplanes, and the absence of these means of correcting the range kept the big German guns from taking their usual part in the fray.”

All that aviators can do, while there is a spell of misty weather, is to prepare themselves to ascend at a moment's call. Then, should there be even a temporary lifting of the mist, they can rise and fly at high speed, making their observations and returning before the land is again obscure. Even during an hour's lightening of the air, with one of the fastest scouts, a useful flight can be made.

The fire from land-guns, while it has harassed the airman, has not prevented him from aiding his artillery, any more than it has checked him in his task as a scout. Occasionally machines have been struck, and have been either damaged or destroyed ; but usually, by flying high and changing constantly their height and direction, they have managed to dodge the stream of bursting shells. A greater menace has been the attack

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of hostile planes. A determined enemy, using fast-flying, well-handled craft, may succeed frequently in beating off range-finding aeroplanes as they approach its lines ; and if it can do so, and maintain this command of the air, the long-range gunfire of its opponent must suffer in accuracy. Fighting aeroplanes are, indeed, by far the best protection against an aerial range-finder. A fast air-scout, with all the sky open to him, may dodge a defending patrol and see things he should not be allowed to see ; but the range-finding pilot, with one definite area to observe, and with orders very often to locate the position of a single battery, cannot pick or choose his route. He must not only reach a certain point, but hover about above it till he can discover what he has been sent to find. This renders him susceptible to an attack from the air ; and even if a hostile plane cannot wing him, through lack either of speed or armament, it may so harass him that he has little time to spare for the actual work in hand.

**PART SEVEN**  
**AERIAL FIGHTING**



# I

## STRATEGY OF AN AIR OFFENSIVE

*"If the flying machine is to prove useful to us, it will prove equally so to our enemy. It is therefore necessary to consider how we may prevent him from benefiting by its use. The only certain method appears to be to attack his air-vessels in the air."*

BRIGADIER-GENERAL CAPPER, C.B., R.E.

IT is inevitable, when contending armies have flying craft, that there should be combats in the air—inevitable because, according to the strategy of war, each Commander-in-Chief must, by assuming an offensive wherever possible, seek to rob his opponent of the advantage that the use of aircraft may provide. It is not sufficient for the airmen of the two armies, each flying out upon their daily tasks, to ignore or elude each other. That is not war. Whatever weapons may be available, and whatever their purpose, it is the aim always to deprive your enemy of their use. If you can do this, and still employ these instruments yourself, then you obtain a material advantage.

With the aeroplane, immediately it was recognized as an instrument of war, and one with

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which any nation—provided it had money to spend—might equip itself, there arose this vital problem : how shall we, while making the fullest use of these machines ourselves, prevent our enemy from benefiting by them? There appeared two methods which were feasible. With one, that of gunfire from the ground, we have dealt already, and shown it to be insufficient. There remains no choice, therefore, as to an alternative : we must fight the enemy in the air, and strive, by meeting him thus in his own element, to achieve results that are impossible with artillery. It is essential that the enemy should be harassed whenever possible, and driven from the air. Aeroplanes are his eyes ; they give him a field of vision almost unlimited. Whatever we may do, whatever manœuvre we may attempt, he will see the scheme actually in its making, and be prepared with a counter-move. We, having aeroplanes, can see what he does also, which is satisfactory so far as it goes. But it does not go far enough. If we, and our enemy, both have the unchecked service of this all-seeing eye, then a condition of affairs is created which may be likened to that of stalemate. He sees, we see ; all the cards are on the table ; and those brilliant coups and sudden attacks, following on forced and secret marches, such as Napoleon was master of, cease to be possible.

“ It would seem,” Major-General Henderson writes, discussing the effect of aviation upon operations, “ that strategic surprise would be

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almost eliminated from the possibilities of civilized warfare, in so far as surprise is dependent on concealment." If, indeed, the airmen of both armies are active, and their information is constantly to hand, the possible moves for each Commander, the actual dispositions he can make with the troops available, are restricted appreciably—when compared, that is to say, with such strategy as might be possible were there no aeroplanes in flight. Matters are not, of course, brought actually to a standstill. A Commander may, even should his movements be observed, work out a scheme which will meet these new conditions. The strategic position brought about by the aeroplane is favourable, in a general sense, to the methods employed by Napoleon, the originator of war as it is waged in modern times ; although blows to-day need to be far more rapid than he delivered them, and they must be struck also with an infinitely greater force. Napoleon's theory was, whenever possible, to bring his entire army into one huge yet well-organized mass, and hurl this, after a few days' marching, on that portion of the enemy's position he considered most vulnerable. Clausewitz favoured such campaigns of ruthless energy ; Moltke developed the ideas of Napoleon, pinning his faith also to the crushing of an enemy by a series of quick, heavy blows, each struck by an enormous force of men. To-day, having the aeroplane to reckon with, a Commander must concentrate his energies on the strength and rapidity of his movements,



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seeking always to strike an enemy where he is weak numerically, and before he can reinforce himself.

As a campaign unfolds there are, almost inevitably, certain positions that must be reached if possible and held. Both Commanders see these positions; both are aware, thanks to the aeroplane, that the other is striving to gain them. In such a case, therefore, the problem is reduced to one of speed. How quickly can a division or an army corps be moved? Can such-and-such a position be reached, either by the use of railways or motor transport, before the enemy can place an effective force there? A Commander-in-Chief to-day, more than ever in the past, must, as he pores over his maps, bear two considerations in mind: they are those of distance and of time. How soon can this river be reached? How long will it take to place a force along that line of hills? How best can we use the railways and roads so as to shorten the distance of our journeys? Such problems have existed always; but to-day, through the advent of the aeroplane, they have become all-important.

And the Commander must think, not only for himself, but also for his enemy. "Put yourself in the other's place" has always been an axiom of war; but nowadays, since the adoption of aircraft, it has become more than a useful saying: in many of the circumstances of a campaign—in most, as a matter of fact—it is vital that the

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Commander, while planning his own scheme, should have the enemy ceaselessly in mind ; the exact distance of the hostile forces from various points ; how long it will take them to reach specified areas ; what the response of the enemy will be to a certain move, made at a certain time and in a certain place. This, of course, means nothing new ; upon such pre-occupations are built the tactics of war. But the outstanding point to-day is this : such considerations of time and space, such swift and delicate moves, must be elaborated till they attain a perfect accuracy. In the old days, when war was more or less haphazard, a delay of twenty-four hours, or even more, in reaching some position was not necessarily fatal ; to-day, with each move followed so promptly by the next, and with each Commander having the battle-field set before him like a chessboard, a mistake of one hour, or even of half an hour, may make all the difference between victory and defeat.

Tactics are extraordinarily difficult, the chances for a brilliant move extremely few, so long as the enemy has scouts in the sky. If his air fleet can only be routed ! If it can be crippled even partially, or harassed in its work, what an advantage will accrue ! "A Commander without information," says Major-General Henderson, "is like a man blindfolded ; he knows neither where to strike nor from what quarter to expect attack ; he is unable to make a plan himself, or to guard against the plan of his enemy."

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So the aim of a flying corps, at the beginning of a war, is not only to scout and direct artillery-fire, but also to attack the enemy's aircraft whenever they are met, and prevent them, so far as is possible, from gleaning the information they have set out to obtain. One Commander-in-Chief, for example, may be making a flanking movement. If he can prevent an opponent from seeing this operation, his chance of success obviously will be increased. On the earth, therefore, he throws out a protective screen of cavalry, seeking to make this impenetrable. And in the air, if his flying corps is strong, and assumes a definite offensive, he may do much to restrict the operations of hostile scouts. To checkmate air-scouts entirely, remembering the vastness and freedom of the air-space, and the fact that machines fly at great speeds and may take cover among clouds, is enormously difficult. To draw such an aerial cordon that no enemy craft shall, under any conditions, be able to penetrate it, represents indeed a task that is hopeless. A bold and skilful pilot, favoured by weather and with a fast machine, will slip through somehow and see something of what lies beyond; but his movements may be so harassed, once he is detected and pursued, that it will be difficult for him to make observations that have clearness or precision.

Though it may be impossible to exclude altogether these single scouts, mounted on racing craft, it is not impossible to form such a barrier,

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first by vigorous fighting and then by means of patrols, that the enemy's initiative is broken, and he loses nearly all the advantages an air corps should provide. Even in this war, with few fighting aeroplanes worthy of the name, and with everything to learn both as regards weapons and tactics, it has been possible for one air service, by dint of constant fighting, to wear down and weaken the efforts of its opponent; and it is vastly to our credit that the corps which first assumed the offensive was that of Britain, and that the corps which suffered—both morally and materially—was that of Germany. This is written, of course, in no depreciation of our Allies, either French or Russian. But in the natural unfolding of the campaign, and particularly in its early stage in the West, it fell to the lot of our small but excellently equipped corps, operating on the French left, to strike first at their German foes, and initiate that scheme of fighting in which we were supported afterwards so admirably by the French.

In one of our Headquarters reports, issued on September 11th, it was explained: "the tactics adopted for dealing with hostile aircraft are to attack them instantly with one or more British machines." This was our policy from the commencement of the war, and it was so rigorously pursued that, in the phase of the operations which immediately preceded and followed the fighting around Mons, we were able to shoot while in flight—and in a series of actual

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duels—no fewer than five German aviators. Our Headquarters Staff bore witness to the fact that, as a result of this bold and dashing work, “something in the direction of the mastery of the air has already been gained.” How valuable such a supremacy could be was quickly made apparent. Our army, having fallen back nearly to Paris, turned at the critical moment and struck at the German right. It was highly necessary at this juncture—if such restrictive work was possible—to head off the German air-scouts, and prevent them from seeing this forward movement of the British troops. Our Flying Corps received instructions accordingly; and they acted upon them with such spirit and intelligence that, at any rate during the period that was mainly critical, the enemy’s aeroplanes were attacked and driven off, and their flying impeded so seriously that it was impossible for them to gain news of value.

## II

### CRAFT USED FOR FIGHTING IN THIS WAR

*"Victory will rest with the instrument which is the most mobile, most rapid, most invulnerable, and most audacious."*—GENERAL CHERFILS.

IT is one thing to say that aircraft should, by all the theories of war, fight each other for the mastery of the air; and quite another, at the present state of development at any rate, to say how this fighting should be carried out, or to frame rules for actual combats—such as may be done in the fighting of land or sea. Aerial fighting was, prior to the outbreak of this war, a problem of the vaguest surmise. Peace manœuvres had shown this: that aircraft would, if they survived the fire of artillery, do excellent and perhaps revolutionary work as scouts. But all that was suggested, in regard to fighting, was that one airman might, by swift manœuvring, pass across in front of an antagonist and seek to blow his machine over by the wind-draught from his propeller. There was, when war came, no experience on which

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to draw ; nor, for the matter of that, were there aeroplanes which were really fighting craft. One or two had, quite experimentally, been fitted with machine-guns ; but they were sluggish in consequence, owing to the extra weight they carried, and the problem of their stability needed further study. There was bomb-dropping, of course, in which a certain amount of practice had been obtained ; and in regard to which also there were data to hand from the wars in Tripoli and the Balkans. But it was recognized that, in view of the difficulty of hitting an object on the ground with a bomb, even when this object was stationary, it would be infinitely more difficult for an aviator, armed with nothing but bombs, to rise above an enemy and pass directly over him, and then, just at the precise moment, drop a bomb accurately upon a machine which, like his, was in rapid motion through the air, and at perhaps a higher or a lower speed.

Then came the war—years too soon, certainly, for the fighting aeroplane. Yet, almost as soon as hostilities had begun, it was seen that aerial fighting would be necessary ; that it would, indeed, owing to the failure of artillery, present the only means possible of harassing enemy aircraft in their work. There was no question of waiting for a perfected fighting craft ; the machines that were to hand had to be taken—machines, that is to say, which had been built primarily for scouting—and adapted as well as

## Craft used for Fighting in this War

might be for the purposes of attack. There were, of military aeroplanes available, only two types that needed consideration. One was the fast scout, carrying a single occupant at high speed, and capable of raising very little weight beyond that of this one man; the other a larger, and more slow-flying machine, which would carry passenger as well as pilot. From this second type there emerged, later in the war, a powerfully-engined biplane, armed with a machine-gun, that was used with success. But, in the first critical phase of the war, there were only the two machines to choose from—the high-speed single-seater, and the appreciably slower craft which would carry two men. So, when he was intent on battle with an enemy craft, a pilot needed to consider, before he took the air, which of these two machines he would fly; and naturally, in making such a choice, he needed to form as accurate an estimate as was possible of the tactics of aerial war. Not that these tactics were in the least clear or well-defined. It meant indeed, such warfare being entirely new, that each pilot made his own rules and applied them in his own way; but it was seen, none the less, that there were certain fundamental advantages which, in any combat and under practically any conditions, might be sufficient to give one aviator victory over another.

The first of these, if it could be obtained, was that of speed. One must, to appreciate what this advantage means, picture the conditions



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under which aerial duels are fought—at any rate in this war. One important factor, naturally, is that of armament. What weapon can an aviator use? There are, as the campaign has shown us, four which are available. They are machine-gun, rifle, revolver, or bomb. The steel arrows such as we have described might be employed, perhaps, but there is no record of this having been done; and there would, in any case, be the difficulty with them, as there is with a bomb, of aiming them with accuracy when discharged from a machine that is moving quickly, and at another in equally rapid motion. Bombs certainly have been dropped in more than one aerial duel. And as to machine-guns, though they are excellent weapons, there were few aircraft from which, at the beginning of the war, such guns could be used with success. So, at any rate in these first encounters, the choice reduced itself to one either of a rifle or revolver.

Assuming the use of one or other of these, the next point concerns the vulnerability of machines. Here, as may be imagined, the result is much what it would be in the case of gunfire from the ground. Bullets may strike a machine dozens of times, and do nothing more than pass harmlessly through its planes. Not unless the pilot himself is hit, or a working part of his machine, can gunfire prove effective.

When a pilot comes within range of an antagonist, and begins to fire on him, there is

## Craft used for Fighting in this War

one position of advantage from which, can he but gain and hold it, his bullets are most likely to prove effective : and this is above his foe. When he is fired at from below, and is flying either a biplane or monoplane, an aviator cannot be seen by his assailant. He is hidden by the sides and floor-boards of the hull in which he sits. And in the same way, owing to their position within the hull, the vital parts of a craft are concealed and to a certain extent protected. But, if an enemy appears above him, the aviator is very susceptible to attack, and more so in a monoplane than in a biplane. In the monoplane, its wings stretched on either side of the hull, there is nothing between the pilot and his antagonist above. To the attacking aviator, indeed, the interior of the hull of his adversary lies completely exposed, with its steersman as a fair and conspicuous mark. When he is in a biplane, and is attacked from above, an airman's position is more favourable. His upper plane will, at certain angles, lie between him and the enemy, obstructing the latter's aim. But this protection is slight ; the attacking airman may, by manœuvring a little forward or backward, obtain a view down into the enemy's hull, either in front of or behind this upper plane.

There is another advantage in delivering an attack from above. The airman who is underneath, apart from the peril in which the mere position places him, is in a difficulty when he replies to his enemy's fire. He must lean back in

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his seat, if he is using rifle or revolver, and aim above his head at an awkward angle.

To rise above one's adversary being so important, as a preliminary to a combat in the air, every effort must be made to gain and hold this point of vantage. But unless a pilot has a fast machine it will be difficult for him, no matter how skilled he may be, to manœuvre himself into the altitude and position he desires. Speed is essential. Without it he cannot force a combat; nor, even should he be able to force one, can he bring it to a definite issue. When hostile aircraft meet, and one is faster than the other, and can climb more rapidly, this machine has a tactical advantage which should outweigh all others. Its pilot is master of the situation. If he does not wish to fight—being the bearer, perhaps, of vital news—he can trust to his speed and leave his opponent far behind; or, should he be ready for a duel, he can rush in at his foe, climbing as he does so, and seek to sweep above him and cripple him with his fire.

Speed, climbing power, and an ability to manœuvre quickly—these, therefore, are the factors that spell success. The weapons an airman carries are scarcely so important as the inherent qualities of his machine. Suppose, for instance, he can mount a machine-gun on his craft. This is a far more effective weapon, naturally, than a rifle or revolver. But if the carrying of this gun reduces materially his speed, as is inevitable, then the advantage he gains by

## Craft used for Fighting in this War

it, merely as a weapon, is lost completely. Even if he has a machine-gun, and can fire it accurately, it is useless to him in any meeting with a faster-flying foe. The latter, if he is less formidably armed, will simply avoid a combat. His speed will keep him out of range; and nothing the pilot of the slower-flying craft can do will bring him within striking distance. A pilot must choose a machine that will bear him, with the greatest rapidity and certainty, to the position of advantage; then, when he has secured this tactical position, he must have some weapon that will enable him to kill or wound his opponent, or cripple his machine. And so our British pilots in Belgium and France, when they went out first to meet the Germans in combat, selected as their craft a light, single-seated biplane, powerfully engined, and rapid in flight and in ascent; and, by way of weapons, they took with them long-barrelled service revolvers, which would throw a heavy, man-stopping bullet. These weapons they could use with one hand, firing down over the side of the hull, while they controlled their machines with the other. With such a machine and such a weapon, the tactics were to drive at an enemy, instantly one was sighted, and pass as close above him as possible, emptying the revolver at point-blank range.

### III

## EARLY COMBATS

*"How will aircraft fight? In the same way as all fights between birds have ever taken place. When a falcon wants to attack a raven, it first pursues it: and as soon as the raven finds it is overhauled, it ascends slowly in spirals and the falcon starts to rise in a parallel line. If the raven can rise higher than the falcon, it is safe. If it cannot, its resource is to drop to earth, although during the descent it is liable to be hemmed in by the falcon."*

THE LATE CAPTAIN FERBER.

IT was when the Germans first threw themselves on the Allies, after the fall of Namur, that it was realized aerial fighting would, in spite of the crudeness of the machines and weapons, play a definite part in the war; and these aerial combats were provoked, indeed they were compelled, by the constant use the Germans made of aeroplanes in controlling the fire of their artillery. The co-operation of the airmen was so successful, the fire thus guided was so damaging, that something had to be done to interfere with it; and, as we have shown, the use of guns from the ground had failed to prove effective. So our British aviators, initiating tactics that were boldly

## Early Combats

offensive, ascended in their fast, single-seated machines, and sought to shoot down, or drive away, the German pilots who were flying above our lines.

To assume the offensive, to precipitate an air combat, requires not only great dexterity, but a determination and courage that are exceptional. A high-speed aeroplane, moving at perhaps a hundred miles an hour, or even more, needs the utmost skill in its handling, quite apart from any question of pursuing or out-manceuvring an enemy. The airman and the foe with whom he is engaged change positions in regard to each other constantly, and with a bewildering quickness. They have no fixed point, no plane on which both move. One moment your enemy may be over your head; the next he may have dived beneath you; the next, by a rapid sideway swing, effected just at the critical moment, he may have eluded you and darted away. Firing from the air is extraordinarily difficult. From a machine, travelling very likely at twice the speed of an express train, you are aiming at an adversary who is also in rapid motion. And, lurking always at the back of the airman's mind, must be the thought that one unlucky shot, striking he himself, or a vital part of his machine, may send him to his death in a fall from which there is no escape.

We have shown the advantage of a light, fast, quickly-handled machine; and this advantage, in nearly all these aerial combats, our aviators

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held and made the most of. The Germans, at any rate in the earliest phase of the war, had no suitable machines they could pit against our rapid scouts. Anticipating the wear-and-tear of active service, and wishing to give their pilots an aeroplane that could be flown with ease even in a high and gusty wind, they had produced machines that were metal-built and admirably strong, and which—by the sweeping back of their planes and by the uptilting of their wing-tips—had a large degree of stability when in flight. But this method of construction spelt weight; and the bird-like shaping of the wings, though it served its purpose well, reduced to a certain extent the efficiency of the machines from the point of view of lift. And so the net result was that, though the German craft would fly extremely well, and were admired even by their enemies for their strength in construction, they could neither fly so fast, nor ascend so quickly, as the lighter machines of the British. Later in the war, realizing what this disadvantage meant, the German Air Corps provided itself with speedy machines; but in this first stage of aerial fighting, when attacked by craft which would fly at a hundred miles an hour or slightly more, the German pilots had machines which would not, as a rule, exceed sixty-five or seventy miles an hour. It was this fact, added to the fine piloting of our military aviators, which brought us our early victories, and led to a curtailment of German operations in the air.

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Of stories of these first duels, which have an historic interest, there are few that are trustworthy. The reason is not hard to find. When seen from the earth, even by eye-witnesses whose knowledge may be technical, it is difficult to follow the manœuvres of two contending craft ; while, as to the aviators themselves, their memory of a conflict is often fragmentary ; or, even if it is not, it may be summarized with a terseness adopted by one of our British pilots. He had fought a duel with a German, so high in the air that the machines were almost out of sight, and had descended in peril of his life, with several of his wing-spars shot through, while the German was seen to fly erratically towards his own lines, his motor damaged and some of his control wires cut. Our pilot, under such circumstances, might have been expected to give some impression of the ordeal through which he had passed. But the only comment he made, with a regretful shake of the head, as he climbed from his machine, was contained in three words—

“The blighter escaped ! ”

One excellent impression of an air duel, seen from the point of view of an observer on the ground, was given by a correspondent of *The Times*, who wrote :—

“ A German aeroplane, flying high, visited the British lines. . . . As the machine hovered overhead, well out of reach of fire, a British airman shot up to the attack. The German saw his



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adversary and attempted to attack him from above ; shots were fired, but they missed their mark.

"The British plane swept in a wide circle around its adversary, mounting steadily. The German tried to swoop, in order to open fire at close range from above. A sudden, giddy manœuvre of machines. Shots ! Another swift change of position, German and Britisher almost at the same altitude, but out of range of one another and each fighting for the higher place. A rushing together, the two machines now looking exactly like great birds in combat. . . . The distant sound of shooting.

"Then a great struggle up and down, a darting hither and thither, each airman determined to win the advantage over his foe. . . . The machines advance and retire. . . . Suddenly the Britisher swings above . . . the German reels and seems to stagger . . . and then, travelling more slowly than sight, the sound of shots. . . . The German descends slowly to the ground. He is wounded."

In this duel the British pilot, confident in the ascending power of his machine, sought evidently to avoid a conflict till he had gained a sufficient altitude. But the German, realizing he might be outflown and rendered impotent, strove to bring matters to an issue before his adversary could obtain the higher place. So he darted at the British machine ; but the pilot of the latter, pursuing his predetermined scheme, refused to accept battle just then, and, aided by his superior speed, moved out of range. Then the machines

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climbed for a spell, until the German, seeing that his enemy was certain to out-manceuvre him, again sought to strike his blow. Again there were darts and swerves ; and again the British pilot avoided combat. And so more ascending, in which the German forced up his craft with persistence, but could not equal the rate at which the other machine climbed. Then finally, at a great altitude, the change by the British pilot from defence to attack. His altitude gained, his adversary now below him, he sees his moment has come. A swift turn of the rudder, a rush in at the German, the emptying of a revolver at the figure seen below, and the duel is won.

It is not always that a swift attack succeeds : the aviator may misjudge his distance. For a moment or so, no more, as he passes above his foe, does he find himself in the position he has sought ; and if he cannot make the fullest use of these few seconds, if his shots go wide or his steering is faulty, he may sweep out of range without having struck his blow. The pilot who is attacked is not idle, of course. Though he is at a disadvantage, he still has power to manœuvre ; and if he is skilled and retains his presence of mind, he may swerve or dive just at the critical moment, and avoid being hit by the bullets poured upon him. Then there is another struggle for altitude, such as the late Captain Ferber, one of the pioneers of military aviation in France, has described in his simile of the falcon and the raven.

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“ Every time the falcon darts upon the raven,” he wrote—contrasting the fighting of birds with that of airmen in war—“ the latter will try by means of a clever side-slip to avoid the impact. If the falcon has been dodged there is a respite, for, carried beyond its aim, the falcon loses an elevation which it must painfully regain. The race for altitude may recommence, but now the fight is no longer doubtful ; the raven will finally come to the ground, and will be vanquished.”

Another air duel, in which victory went to the machine that could climb most rapidly, was seen and described clearly by a sapper in the Royal Engineers. The story of this eyewitness, according to *The Daily Telegraph*, was as follows :—

“ He was lying on the ground with his regiment, resting. Suddenly a German aeroplane hove in sight. It flew right over the British troops, and commenced to signal their position to the German camp.

“ A minute later two aeroplanes, with English and French pilots, rose into the air from the British rear. Ascending with great rapidity, they made for the German aeroplane, with the intention of attacking it. . . .

“ The troops lay still, and with breathless interest watched the attempts of the French and British aviators to outmanœuvre their opponent and to cut off his retreat. After a little time the French airman abandoned this attempt, and then the Englishman and the German began to fly upwards.

“ Up and up circled the two airmen, till their

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machines could barely be distinguished from the ground. They were almost out of sight, when the soldiers saw the British aviator was above his opponent. Then the faint sound of a shot came down from the sky, and instantly the German aeroplane began to descend, planing in graceful fashion. Apparently it was under the most perfect control. On reaching the earth, the machine landed with no great shock, ran a short distance along the ground, and then stopped.

“ Rushing to the spot, the British soldiers found to their amazement that the pilot was dead. So lucky had been the aim of the Englishman that he had shot the German through the head. . . .

“ The aeroplane was absolutely undamaged, and was appropriated by the British aviators.”

In this combat, obviously, the British and the German aeroplanes proved better climbers than that of the Frenchman, and it resolved itself into a duel between these two. In this case, again, as in others during the war, it was the British pilot who won the ultimate advantage. That the German machine, after its steersman was shot, should descend in safety, is not so remarkable a fact as may be imagined. The German aeroplanes—those at least which are given inherent stability—will glide to earth unaided when started upon a descent, finding their angle automatically, and moving down quite smoothly until their landing-wheels touch ground. In this case it seems probable that the pilot, immediately he found he was hit, switched off his motor and

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set his controlling-planes for a descent, only to die in the air while his craft was on its glide.

When he is flying a machine slower than that of his antagonist, and the latter bears down upon him, an aviator is not entirely without resource. Should it be a cloudy day, for example, he has a chance of escape that lies close at hand. He may, as did a German pilot near Valenciennes, steer into a cloud-bank and so elude his swifter foe. In this case the German machine was a biplane, reconnoitring above the roads near the French lines. Suddenly a hostile monoplane, quicker in flight than the German craft, appeared from behind the French position. The German pilot saw his peril—also a friendly cloud. He turned, rose as rapidly as he could, and, before the Frenchman was within striking distance, had entered the cloud and disappeared.

It was the presence of mist and low-lying cloud, more than the skill of the pilot, that saved from destruction the German biplane which, passing across the North Sea on Christmas Day—probably in the hope of reaching London and dropping bombs—was sighted while passing above Sheerness and brought to combat by several of our patrol aeroplanes. After a short and brisk engagement, during which it was reported that his machine was struck, though not damaged to any serious extent, the German was able to reach a fog-bank above the river; and, keeping within this as he made seaward, he

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eluded his pursuers and escaped across the coast-line.

There is, when he is hard pressed by a faster foe, another stratagem an airman may employ. He can turn tail when he sees his enemy has the power to out-manceuvre him, and fly back to the shelter of his own lines, descending gradually as he does so, and drawing his adversary down after him, until the latter is in danger from artillery on the ground. In such a case the pursuing airman, rather than fly farther into the danger zone, finds it wise to abandon the chase. A story illustrating this has been told by a German pilot named Werner. He was scouting with a passenger behind the Allies, seeking to locate the positions of reserves, when he was menaced by a British biplane that he saw was a faster craft than his. He steered, therefore, so as to pass above one section of the German line—the British machine in hot pursuit. The latter, having gained the upper position, dived low above the German craft. There was an observer in the British machine, in addition to the pilot, and he and the passenger in the German aeroplane, both being armed with pistols, began to fire at each other. But none of the bullets found their mark. Then suddenly, from a greater altitude, appeared a high-speed French monoplane, and this joined the British airmen in their attack, passing across in front of the German biplane and subjecting it to a fusillade of pistol shots. But no vital part of the machine was struck; nor were its

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occupants harmed ; so they flew on. And just when their position appeared hopeless, and the two other aeroplanes were drawing in more closely, they passed within range of some German guns, which opened such a fire on the French and British craft that they were forced to sheer off, and the Germans descended in safety. But it has happened, often, that a swift machine has caught a slow one when the latter is at a distance from its own lines ; and in such a case the slower machine has no chance, before the duel is forced to a decision, of taking shelter behind its guns.

## IV

### WHAT THE FIRST AIR DUELS PROVED

*"The single combats that distinguished the age of chivalry, when champion rode against champion in front of the closing hosts, were but tame exhibitions before the starry deeds these men will have to do."*

H. G. WELLS.

WITH surprising quickness, remembering that aerial warfare had never before been waged, the aviators who fought decided on their tactics, and planned schemes of attack ; and in each case the keynote was a bold, swift initiative. The airman won his combat who, apart from the superiority of his machine, could think more quickly, and act more decisively, than the pilot he opposed.

There was naturally, after a number of aerial duels had been waged, a certain amount of data available for the aviators' guidance. A point that emerged, and a fairly obvious one, was that the airman armed only with a revolver, who attacked an adversary who had a rifle, ran a risk owing to the longer range of his opponent's weapon. This was shown in one of the earliest duels fought. A British single-seated scout, a



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fast 100-h.p. craft, encountered a German biplane, in which there was a passenger in addition to the pilot. The British aviator, flying alone, had no weapon save a revolver ; but his speed was greater than that of his antagonist. So he adopted tactics which seemed best to suit the case, and strove to rise above the enemy before closing in. This he was able to do without difficulty, the German craft being his inferior in manœuvring, as well as in speed. Then, having gained sufficient altitude, the British pilot darted at his foe. But the latter, though out-flown, was ready to make a spirited defence. While the German pilot concentrated his attention on the controls, his passenger took up a repeating rifle and, aiming upward with such accuracy as he could command, directed a stream of bullets at the oncoming machine. The British aviator, not yet within revolver-range, had to fly on without replying to this fire, trusting to his speed, and the fact that he offered a difficult target, to save him from being hit. But the German passenger was a marksman. After puncturing his enemy's planes with many bullets, he sent one at last into the hull. This, reaching the pilot as he sat in his driving-seat, wounded him severely in the thigh, and put him out of action. Luckily for him, however, though all chance of victory was gone, he did not lose control of his machine, and was able to pilot it back towards his own lines, landing without accident. The German biplane, freed of a dangerous foe, flew

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on without further attack and regained its starting-point.

It was shown by later duels that, even when pitted against a machine that has superior armament, a smartly-handled craft may gain the victory. At the critical moment, granted he has the position of advantage, the pilot may so place his aeroplane that the enemy is, as he attempts to fire, obstructed by some portion of his own machine. This manœuvre is accomplished more readily when the machine attacked is a biplane. The airman passes over it at such an angle and in such a position that, at the moment the craft approach nearest each other, the upper wing of the biplane interferes with its marksman's aim. Or, when the craft that is on the defensive is a monoplane, with its passenger seated between the pilot and the engine in the bow, the attacking airman may, by crossing in front of his opponents, cause the propellor of the monoplane to obstruct its combatant's fire. In all such tactics, of course, it is the personal dexterity of the pilot, and his rapidity in forming a decision, which prove the vital factors.

It was recognized, none the less, that, apart from questions of exceptional skill, the aviator who had only a revolver was, when in conflict with a craft that could outrange him by the use of a rifle, placed at a disadvantage that might prove serious. But at the same time our pilots, having achieved success with single-seated craft, were in no mood to abandon them. Yet when a

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man was alone in a machine, and had to be combatant and pilot combined, he could not handle a rifle. A solution of this difficulty, and an ingenious one, soon presented itself. Aviators who flew in single-seated machines, and could not free both arms to use a weapon, fixed a couple of rifles along the sides of their craft, one each side of the bow, and pointing downward at an angle which would be most convenient when firing on a foe. There was also, in the attachment of the rifles to the hull, sufficient play to allow of their being aimed. The pilot, his weapons thus held in position, had only to lean forward, grip a rifle in one hand, and pull the trigger when he came within range.

One of our aviators, flying a high-speed machine which had been equipped in this way, came in sight of a German biplane—a craft he recognized as of a type far slower than his own. He saw also that the German machine was driven by a propeller behind its planes; so he manœuvred to attack his enemy from the rear, knowing that, so long as he was astern of the biplane, its occupants would be hampered in their fire by the position of their own propeller. He closed in till he was within sixty yards of the rear-planes of the other craft, then aimed and fired one of his rifles; but the bullet did no vital harm. He had no opportunity for a second shot, because the speed of his machine carried him above and ahead of his quarry. All he could do was to swing in a circle and manœuvre to

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regain his position of advantage. This, thanks to his speed, he did ; and at the second attack, wishing to leave as little as possible to chance, he emptied the magazine of one rifle at the biplane's hull. The result was quickly seen. The German craft, which had hitherto been flying doggedly ahead, now began to lose altitude rapidly, as though either its pilot had been wounded or some working part of his machine hit. The British aviator, not content to relinquish the chase till he was sure of his foe, switched off his motor and began to plane after him. With his machine gliding down, he found he could free for a moment his hands, and attempted to refill his magazine. But unluckily the mechanism jammed, and he could get only four cartridges into place. These, however, he fired as quickly as he could at his descending foe. But they seemed to have no effect. The British aviator was, in fact, fated to lose his quarry. Both machines had, at the time of their conflict, been flying high ; and below, and between them and the earth, lay a bank of cloud. Into this, planing apparently so as to reach the ground, the German biplane plunged and disappeared. The British aviator followed him promptly, and emerged at length on the lower side of the cloud-bank. But there was now no sign of the enemy, although his pursuer, restarting his motor and flying at high speed, sought for him high and low. Either he had landed or, changing his direction while passing

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through the cloud, had emerged from it at some point far distant from the scene of conflict.

This combat, apart from the light it throws on tactics, is instructive in another sense. It shows how easy it is, even when one of the combatants employs forcing tactics, for an air duel to prove inconclusive. This, in fact, owing to the speed of machines and the inefficiency of weapons, has been one of the lessons of the war. Many fights have occurred, but few, relatively speaking, have been brought to a definite issue. This has been inevitable ; it casts no reflection on the combatants. One needs to picture, though it is not easy to do so, the conditions under which these fights are waged. Comparisons may be made, of course, between fighting in the air and that on land or water ; but there is, in all air duels, one vital point in which they differ from the contests of land or sea. Combatants on land or sea, no matter what machines they may employ, can manœuvre only, in two directions ; they can move forward or backward, or from side to side. But in aerial fighting, besides these evolutions, which can be made at a speed almost impossible either on land or sea, a third movement is possible. The combatants may not only advance or retire, or swing from side to side, but climb upward steeply, or dive suddenly at high speed. And one must bear in mind, also, the vastness and freedom of the air-space, which contains no obstructions, or traps in which an enemy may be hemmed. Some

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idea of the conditions governing aerial combat may be gained if one pictures two horsemen who contemplate a duel—each man riding a swift steed, each armed with nothing more deadly than a revolver, and each setting out against the other from one corner of a huge and empty plain. Even this simile, though it suggests the vast space there is for conflict, and the difficulty of forcing a duel to an issue, makes conditions appear easier than they really are: it makes no allowance for the power of manœuvring up and down. To render the picture more complete, one needs to imagine that the horses have wings, which will carry them when necessary in a flight skyward, or enable them to descend swiftly above a foe.

## V

### AIRCRAFT WITH MACHINE-GUNS

*"Suddenly a tiny ripping sound, rather like a child's rattle heard a long way off, came down, and the German aircraft dipped—exactly as a hit partridge swerves. . . . 'Winged the beggar all right,' said a Tommy, with as much emotion as if he were watching covert shooting."*

MR. PRIOLEAU IN "THE DAILY MAIL."

IF he can be given some weapon more powerful than a rifle or revolver, the aviator has a better chance, naturally, of bringing a duel to an issue. This was realized as the war progressed; and each of the belligerents, mainly by using aeroplanes with high-powered engines, endeavoured to send to the front a craft which, carrying a man and a machine-gun in its bow in addition to the pilot, would fly sufficiently fast not only to meet a machine similarly armed, but also to chase and bring to combat the lighter-weaponed, scouting-type machines.

Undergoing tests in England, prior to the war, were several gun-carrying craft; but, in regard to each, there were problems that needed solution. One was that of speed; though this

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may be dealt with, at any rate to a large extent, and apart from questions of design, merely by the use of powerful motors. Others concern equilibrium and control, and they are more delicate. The weight of gun and ammunition affects the stability of a craft ; it may be sluggish, perhaps definitely unstable, when in the air, and requires ceaseless experiment and alteration before it will fly smoothly, and respond promptly to its controls.

Of machine-guns, such as are suitable for aircraft, there is no lack—the chief need being, of course, that they should be extremely light, and at the same time reliable. One small gun, of a type that is fitted to a number of machines, weighs a little less than 30 lbs. It is air-cooled, and will fire service ammunition at the rate of five hundred shots a minute.

There were, at the outbreak of war, a certain number of French aeroplanes, with motors of 140 h.p. and 160 h.p., which had machine-guns fitted to them. But these craft, owing to their power and speed, and the weight they carried, were difficult to handle ; none but an expert would dare to fly them ; while the risk of damaging them in alighting was so great, owing to the pace at which they made contact with the ground, that few survived for long the rigours of active service. But the need was such that supreme efforts had to be made ; and before long French pilots were given a biplane, steel-built throughout and with large sustaining planes,



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and fitted with a motor of 200 h.p.; and the machine proved so efficient that, in spite of the weight of machine-gun, combatant, and pilot, it would attain a speed of more than seventy miles an hour. This type of craft, of which as many as possible were sent on active service, has done admirable work. British gun-carrying craft, also, have been greatly improved, thanks to the experience of the war.

The value of a machine-gun in an aerial combat, with its comparatively long range, and the concentration and rapidity of its fire, was shown by a fight which took place between a French biplane, flown by M. Louis Paulhan, and a Taube monoplane, steered by one of the German pilots. With M. Paulhan was a passenger whose duty it was to handle the machine-gun, the airman contenting himself with the piloting of the machine. They were on a reconnoitring flight, passing high towards the German lines in the direction of Amiens. Below, here and there, floated a film of cloud. Suddenly, beneath them and to the rear, appeared from the clouds the German monoplane. Paulhan, quick to realize the advantage that his height gave him, swung his machine in a half-circle and dived like a hawk above his foe—bringing himself in one rush to within 500 feet of his enemy. But the German pilot, also, was a man of action. To continue on the course he had been holding was, he saw, merely to court destruction, seeing that he was in a position of

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tactical disadvantage. So, making a quick turn, and diving to increase the speed of his machine, he attempted to avoid the encounter and swing away upon his opponent's flank ; and, had the weapon of the Frenchman been a rifle or revolver, the German would certainly have escaped. But as it was, opening fire promptly with his machine-gun, the passenger in Paulhan's craft, having for the moment a broadside view of his enemy's machine, riddled it with bullets and sent it crashing to earth. A stray shot from the German, fired just before he was put out of action, pierced the petrol-tank of Paulhan's machine ; but the aviator, flying back towards his own lines, was able to land safely near a French battery.

In another instance, which revealed the effectiveness of machine-gun fire, a German biplane was passing above the lines of the Allies when a French craft rose unexpectedly to meet it. The French pilot steered his machine straight at his antagonist ; while his passenger, opening fire with a machine-gun, was able not only to puncture the German's petrol-tank but to shoot dead his passenger. The German pilot began to plane earthward ; but suddenly, owing to a leakage of petrol, the aeroplane burst into flames, and he was burnt to death before he could escape from the blazing craft.

It was suggested, prior to the war, that one aviator—finding himself in a hopeless position during a combat—might turn and deliberately charge his foe, with the idea of wrecking both

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craft in a shattering impact, and involving himself and his opponent in what must prove almost inevitably a fatal fall. But in actual fighting, as seen in this campaign, there has been one instance only of such a desperate and despairing move. Nor is this surprising. The pilot who charges another machine, when at a high altitude, knows he is flying to almost certain death; there is not even a sporting chance of his being able to escape with his life. Few men would be willing thus to relinquish hope. And there should be no need for them to do so. From almost any predicament, during an aerial duel, there should be some chance for a pilot to extricate himself.

In the only case of attempted "ramming" that is on record, a German airman drove his craft against that of a Frenchman. The French machine, a biplane, was patrolling near Amiens. A sergeant-aviator was in control, while a lieutenant, flying with him as a passenger and observer, was armed with a small machine-gun. The German aeroplane was sighted when at some distance, and the Frenchman went in chase of it. The French biplane proved the faster craft, and the German was overtaken while above a village named Cailly, over which he was dropping bombs. The French pilot brought his craft within range, whereupon the lieutenant, operating his machine-gun, fired a hundred shots at the German without registering a vital hit. The latter, whose only weapon

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apart from his bombs was a pistol, was at the disadvantage not only of flying slower than his enemy but of having no adequate method of replying to his fire. So he turned his machine, in evident desperation, and drove pell-mell at the other. No great distance separated the two machines, and the German bore down rapidly on his foe. The French sergeant-aviator, unprepared for such a drastic move, was for a moment taken by surprise ; while his passenger, though he continued to use his machine-gun, could place no shot in his adversary such as would stop his swift approach. At the last moment, however, the pilot of the French machine awoke to his danger. He swung his craft violently sideways, being only just in time to avoid the impact. The suddenness of this manœuvre and the strain it threw on the aircraft were such that the machine-gun was unshipped from its position in the bow and rendered useless for further service.

This gave the German his opportunity, and he turned so as to escape towards his own lines. But he was not out of danger. The combat had been watched from the ground by one of the French military aviators who were stationed at Amiens ; and he, taking a mechanic with him who was armed with a rifle, went in pursuit of the German in a monoplane. The latter, who again found his machine the slower craft, was overtaken and turned once more to fight. The French mechanic fired ten shots at him with his

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rifle, but failed to score a definite result ; whereupon the German, replying with his pistol, was lucky enough to place a shot in the petrol-tank of the monoplane, which caused it to abandon its pursuit and plane to the ground.

Many stories are available, most of them dramatic, as to the success that attends the use of machine-guns in an aerial duel. Quite a number bear features that are in common. One fight, however, which took place during the warfare of the Aisne, is worth describing. A Taube, scouting above the French troops, was met by one of the powerful French biplanes such as we have described. The German turned without offering to fight, and made off in the direction whence he had come. The French pilot went after him, his passenger using his machine-gun. But the monoplane was dead ahead and offered a difficult mark ; so none of the bullets took effect. Whereupon the French pilot, creeping a little nearer, dived suddenly. This carried him below the German and slightly to one side of him ; and the passenger in the French machine, firing upward at the bow of the monoplane, punctured the radiator of its water-cooled motor and forced the pilot to descend. The German pilot prolonged his glide, and landed at a point between the French and German lines. Then he, and the officer who had been flying with him as a passenger, sprang from their seats and made a rush to reach their own trenches. Unluckily for them, there was a body of French

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soldiers, lying under cover, nearer than they had imagined. These men opened a sudden fire, and killed both pilot and passenger before they had gone many yards from their machine.

It happens on occasion that two aeroplanes, each armed with machine-guns, and each flying at about the same speed, meet in conflict. In such an event, naturally, victory goes to the craft which is best handled and whose gunner is most accurate in his aim. In future, when fighting aircraft have been evolved of definite types, such equally matched combats will be frequent; while a squadron of hostile craft, meeting another of approximately the same armament and composition, will engage in a combined offensive. Then, owing to the swiftness of the machines, it will be necessary for their Commander to have a rapid means of communication with each of his units engaged. No doubt, by the time we reach such battles as these, a system of wireless telephones will be available. If so, and with these to aid him, the Commander of a squadron, flying high and observing the fortunes of a struggle, could telephone to each machine as he wished, ordering it to advance or retire, as the case might be, or sweep round on one or other of the flanks. Some such method of control appears essential; otherwise an air combat would resolve itself into a series of isolated duels.

The development of air-fighting, as revealed by the war, was practically this: at first, owing to the absence of a fighting machine,

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the air was free to all the combatants, and each of the corps rendered such service as its numerical strength would permit. Then, by degrees, owing first to their boldness and the superiority of their machines, and afterwards to the use of craft which would carry machine-guns, the aviators of the Allies were able to establish a supremacy in the air which, while being only partial, restricted considerably the activities of German craft. With more machines available, this supremacy might naturally have been rendered more effective ; but it seems clear that, so far as a definite command of the air is concerned, we must await the next war. With machines that exist to-day, armed and handled as they are, it would be difficult in the extreme to gain absolute supremacy. War in the air is, at present, a guerilla war. Not until there are large craft, handled in squadrons and capable of dealing a crushing blow, can there be aerial fighting which will be decisive, in the sense that a sea battle is decisive.

## VI

### AEROPLANE V. AIRSHIP

*"The Zeppelin is a delicate monster, fragile, and condemned to an inability to ascend to any great height."*—GENERAL CHERFILS.

NO controversy has been keener, at any rate in the world of aviation, and none based on more slender data, than that which concerns the fighting between airship and aeroplane. Even in this war, in which we have had air combats so fierce that they have outrivalled prophecy, there is no record of a duel between an airship and an aeroplane—none, that is to say, which is authenticated, or of which details are credible. Yet it was thought, before the war, that fights between these craft would be inevitable and frequent. Aeroplane pilots, certainly, have been eager for them, and have regretted they have had no opportunity of bringing matters to an issue. But airships have declined combat, and for a good reason: those who control them have realized that, with conditions as they are to-day, and with such weapons as are available, they would have no fair chance



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in conflict. So, as we have explained, they have confined themselves mainly to night-flying and over-sea reconnaissance, and have left aeroplanes to be fought by craft of their own type.

As it exists to-day, and with no armament that is commensurate either with its size or power, the airship is outclassed as a fighting machine by the aeroplane. The latter flies considerably faster than the airship, and offers a target infinitely smaller. The aeroplane can mount a machine-gun and attack her big enemy with bombs ; and the airship, in defending herself, can rely only on these same weapons. One might imagine, by way of comparison, an unarmoured battleship, equipped with nothing but small, quick-firing guns, being sent out to do battle against torpedo-boats that were similarly armed. The battleship, unable to outrange her enemies, and offering a large target, and moving more slowly than her nimble foes, would have a poor chance of victory. What the airship needs, and what in course of time she may be given, is a weapon of high power—one heavier than an aeroplane can carry, and of a greater range. Some type of quick-firing gun, throwing a stream of explosive shells, seems to suggest itself. There would be the recoil from such a gun to consider, but the vessel might be strengthened specially, where necessary, to withstand this.

The whole problem, from the airship pilot's point of view, is this : unless, profiting by his craft's weight-lifting capacity, he can mount some

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weapon that will keep aeroplanes at a distance, he is virtually lost. The airship's hull is vulnerable; she lies open to attack from above; her only chance, indeed, is to deal with her antagonists at long range. But it is scarcely the mission of an airship to fight aeroplanes. She has, apart from her work as a long-distance scout, one main task; and this is to make use of her weight-lifting power, to carry bombs over some position, and drop them to the best advantage. And in such a flight it is her object not to meet, but to elude, hostile aeroplanes.

The airship is a type of craft which, owing to the large sums necessary for carrying out even simple tests, has developed very slowly; and so it is hardly fair, in this war at any rate, to pass judgment upon what she has done. She is, indeed, in this unhappy position: she is burdened by all the drawbacks of her bulk, without having been able, as yet, to realize its advantages. An example may make this clear. It was realized by German experts, some time before the war, that Zeppelins would be susceptible to attack from above, and that, if an aeroplane manœuvred into position directly over them, it would be able to drop bombs on their hulls without the gunners in the cars below—obstructed as they would be by the gas-chambers above them—being able to reply to the attack. To meet this drawback, therefore, a top-platform was constructed on the airship's hull, and on this a machine-gun fitted, the idea being that the gun

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should fire upward at an attacking plane, and keep this craft at such a distance that it would be unable to drop its bombs with accuracy. In theory this was an excellent move ; but in practice, when the top-platform gun was fired, it was found that the whole airship was imperilled, because, as flame leaped from the muzzle of the gun, it threatened to ignite any gas which might have leaked upward from the compartments below ; and, with such a huge craft as a Zeppelin, there is always a faint leakage, which percolates through the hull. A serious accident, in fact, in which the hydrogen of a Zeppelin was ignited and the machine wrecked, was attributed to the firing of a top-platform gun ; and so the scheme had to be abandoned. In time, perhaps, a type of gas may be used which has been rendered non-inflammable. But in this war, according to reports, Zeppelins have been without top-platform guns.

An inability to use such weapons, from the top of her hull, places the airship at a disadvantage when she meets aeroplanes in conflict. If she is assailed by several craft—as would be the case were she making a raid, or attacking a fortified position—she may be regarded as defeated as soon as one of her adversaries has risen above her. With no machine-guns to keep him at a distance, he may plane low over her hull, and drop his bombs from such a range as to make certain of their being effective. When she is thus threatened the airship would, of

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course, seek to escape by rising ; and until she reaches her limit of altitude—which is at the present time about 10,000 feet—she can climb more quickly than the aeroplane. But the latter, though its rate of ascent grows slower the higher it ascends, may still climb when the airship has stopped, and so win a final advantage and deal the airship her death-blow.

Theoretically, and particularly at the present stage of its development, the airship should be guarded against the attack of aeroplanes, in the same way as a Dreadnought is protected from hostile torpedo-boats, by a screen of light and quick-moving craft. On a raid, for example, in which airships are carrying high explosives to drop them above a certain spot, they should be surrounded as they fly by a patrol of defensive aeroplanes, which should meet and do battle with hostile craft of their own type, and prevent them from coming within striking distance of the airships. But aerial warfare, as practised to-day, has not emerged from its haphazard stage ; and the airship, if she sets out upon a raid, shields herself only by the cloak of night. The Zeppelin is, to a large extent, “a white elephant” in this war ; huge, costly, expected by the German public to do great things, yet placed at such risks, owing to a lack of weapons and organization, that it is only on rare occasions that she has hope of success.

It may be taken for granted that the airship has no chance against aeroplanes during the

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hours of daylight—assuming, that is to say, the sky is clear, and there are no clouds into which she might fly to conceal herself. At night, and particularly on a misty night, conditions are difficult and more in favour of the airship. Her pilot, steering by compass, may travel long distances at a high altitude without approaching the earth; and should he be doubtful of his position and wish to pick up some landmark, he can stop his engines and drift down so silently that, even when he is fairly near ground, there is no great likelihood of his craft being seen. Even if the night is foggy an airship can be flown, though when it comes to a question of finding any specific place—say, for example, a town or city—the existence of the fog will make identification very difficult, and render it impossible to drop bombs with precision. Still, if he steered by compass, and was not troubled by side-winds, and if he could detect from some distance the faint light-haze which hangs above a city—even when its illumination has been dimmed—an airship pilot might grope his way to his mark, and drop bombs with the knowledge at least that they were falling on the city, even if he could not be sure he was bombarding any given locality.

The aeroplane can be flown at night. In France, during the war, our naval airmen have made night-flights above the enemy, dropping bombs and harassing troops in bivouac. In one instance, making a night air-journey of a hundred

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miles, one of our aviators delivered an attack on a temporary aircraft shed the Germans had established near Brussels, passing low above it under the shield of darkness, and setting it on fire with incendiary bombs. But with aeroplanes, in the stage they have reached to-day, and with engine failure represented by an ever-present risk, the question must be asked, in organizing a night-flight, whether it is justified. Each time a pilot ascends, when it is dark, he endangers his own life and runs the chance of wrecking his machine ; and neither men nor craft should be risked lightly. If he starts from an aerodrome with which he is familiar, and can return to it again in safety, being guided in his descent by flare-lamps on the ground, then the risk he runs is not so great. The real danger, and one that cannot be guarded against, is that his motor may fail while he is in flight over a tract of country with which he is not familiar, and which he can see only dimly below. In such a predicament, planing down through the darkness and being unable to choose his landing-point, he may strike the roof of a house or a wall, or dash into a hedge, breaking his machine to pieces and perhaps losing his life.

What those who are interested in aviation have hoped to see in this war, and have not yet seen, is a conflict between airships and aeroplanes under conditions which are favourable to the former ; during, that is to say, the hours of darkness. As to the result of a combat in daylight

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there can be little doubt ; it would possess hardly a sporting interest. But at night, if their opportunity is chosen with care, and they are skilfully flown, airships might creep up to a city guarded by aeroplanes, drop their bombs as quickly as possible, and endeavour to escape without being brought to conflict. The exploit would not be glorious, even should it succeed, but it might conceivably prove of value to the enemy attempting it. In such a case, of course, when the city they were protecting was menaced, aeroplane pilots would ascend, running the risks that attend night flying. Their finding of the airships, and the fortunes of the conflict that might follow, would depend largely upon atmospheric conditions, and also upon what warning the airmen had received of the airships' attack. The latter would, at any rate in the first instance, have the tactical advantage : they would be already in the air, that is to say, and in a position to deliver their blow ; while the aeroplanes, at the word of warning, would need to be drawn from their sheds and then climb upward to find their foe ; and these operations, of course, would take time. If the warning came late, and the raiders were actually delivering an attack when they were perceived, they might escape before the aeroplanes could rise within striking distance. And it would scarcely be feasible, unless an attack by airship was known to be imminent, for aeroplane patrols to be sent up regularly by night. There would be the constant

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risk of engine failure, bringing a machine down at some point where no safe landing could be made ; and owing to this danger, if night flights were persisted in, a number of men and machines might be lost by accident before the threatened raid was carried out. But an airship attack to-day, made from a long distance, and against a city prepared for defence, is in the nature of a great adventure—almost, indeed, of a forlorn hope.

Whether the large airship will survive, and play her part in struggles of the future, is a moot point. But it is unwise to judge any apparatus, and particularly a machine intended for war, till it has attained a reasonable state of perfection. The airship has not, for instance, though it is already large, reached by any means its limit of size. Technical difficulties, under which it labours to-day, might be overcome were it made bigger ; and it is probable that, as time goes on, there will be airships which are six times as large as those used in this war. Such machines might be able to carry formidable guns. They would be able to fly faster than any existing craft of their type, and would possess greater climbing power.

The aeroplane, also, will move towards perfection, growing larger and swifter in flight, and being more heavily armed. So there may be a race for power between airships and aeroplanes—the power to strike a quick and crushing blow. It may be that the airship will continue to dis-



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appoint her supporters—as she has in this war. The aeroplane may develop so rapidly, and may be given such a powerful driving plant, and such efficient sustaining-planes, that it will be able to achieve, in the matter of weight-lifting and radius of action, all that can be obtained with the large airship ; and in that case, for purposes of war, the latter will be doomed.

In the large fighting aircraft of the future—the machine that must be used in battle for the delivery of a decisive blow—two features at any rate are essential : the first is speed, which spells the power to out-manceuvre a foe ; and the second a capacity to raise heavy weights, which means that large guns may be fitted, and that a craft may be armoured to protect her vital parts.

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